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Volume 9 • Issue 49 • 2003

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- *Temperature increases, power and energy production in metal hydrides/deuterides; calorimetry relevant to such experiments*
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- *Electrochemical issues concerning loading, surface chemistry, resistance diagnostics, and other issues concerning metal hydrides/deuterides that relate to anomalies*
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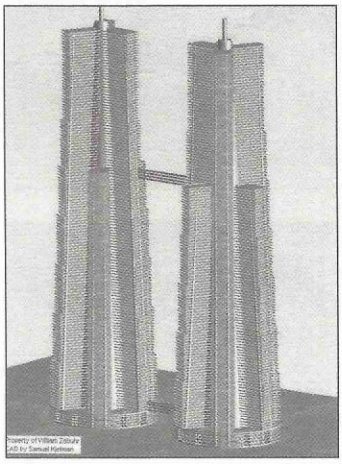

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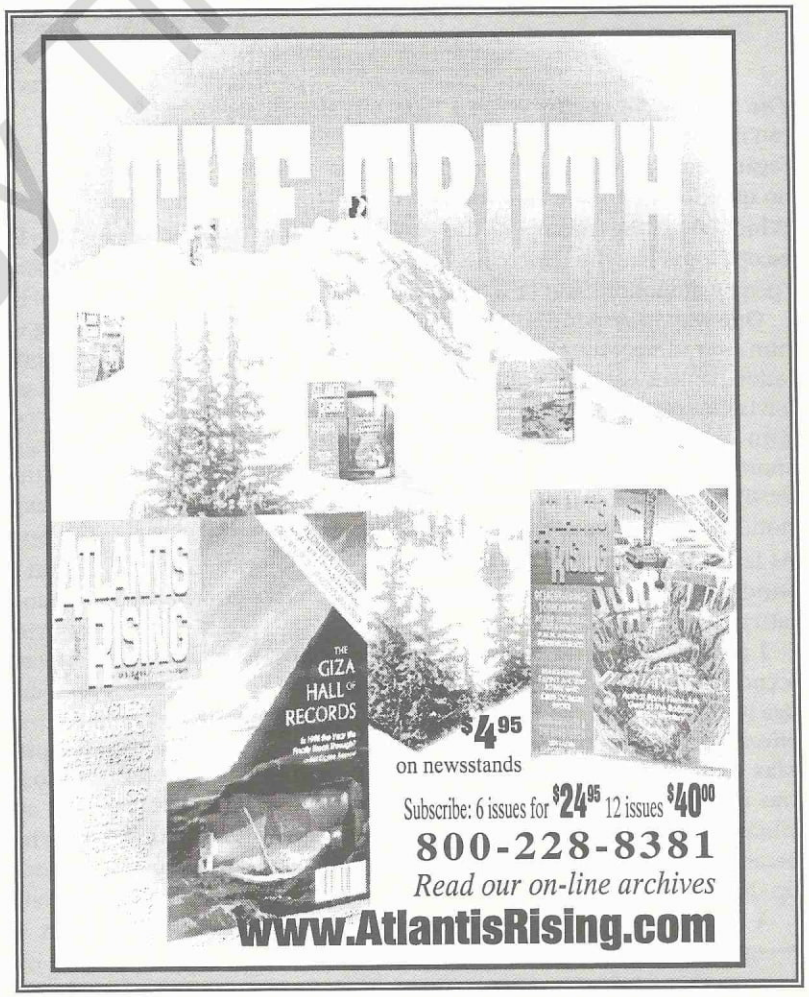

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LETTERS TO THE EDITOR

Tethered Solute Molecules

I thought the idea of tethering solute molecules (Kevin Varner, "Perpetual Motion in the 21st Century: Tethered-Solute Osmosis Membranes and Other Concepts for Demonstrating Second Law Violation," Issue #43) was really clever and it took me some time and consultations with my professors (especially Dr. Noel DeNevers) to figure out what was wrong with it.

Essentially, osmotic pressure is generated because on one side of a semi-permeable membrane 100% of the molecular collisions are solvent molecules which can pass through the membrane; and on the other side <100% of the molecular collisions are solvent molecule because some of the solute particles are in the way. The reason tethered solute molecules wouldn't work is that the top surface of the tethers essentially act as a second osmotic membrane. Above the tethers, the solution is 100% solute and 100% of the collisions can pass through the boundary between the tethers and the solute, but within the tether layer <100% are solvent molecules.

The osmotic pressure generated by the top of the tether layer is equal and opposite to the pressure generated across the semi-permeable membrane and so there is no net flux of solvent and no Second Law violation. I do not think it would be possible to construct the device in such a fashion that the top of the tethers would not act as a second membrane.

Mike Homel
Salt Lake City, Utah

The Author Responds: What I hear Mr. Homel saying is: "It can't work, but I don't know why." This reminds me of Carl Sagan's quip concerning the alleged "canals" on Mars: "There is no question that there are canals on Mars. The only question is: Which end of the telescope?" The view through my end of the telescope looks like this: Disconnecting the words "impossible" and "perpetual motion" will be a major battle.

One way to respond to Mr. Homel's comments is to implore him to read my latest article on the subject of Second Law violation, in this issue of *Infinite Energy*. In one part of my essay, I advise skeptics of tethered solute osmosis to come out with a firm number/dimension/parameter predicting (someplace short of molecular level) where a shrunken version of the manifestly workable Figure 7 simulator suddenly stops simulating. I notice that Mr. Homel does not deal with my issue in this way. As far as that goes, Mr. Homel steers clear of objecting to self-winding nanowatches. Doesn't he also have a problem with the latter machinery?

I propose that there is something more going on that transcends any objectively logical resolution process. We can crystallize it in five words: *the law of cultural inertia*. This "fuddy-duddy effect" has been seen before in scientific history, as embodied in Max Planck's comment concerning the way quantum mechanics was received: "A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it."

A law that predicts (in effect) that everything decays must eventually become a victim of its own premise.

It is regretful that the process of Second Law decay and death did not begin thirty years ago around the time of the Arab Oil Embargo. Think how much more advanced our energy technology could be if only somewhere in the world a professor had decided to break ranks in 1973 and take a firm stand against the Second Law. Had this occurred, many of the nastier by-products of "petrodollar recycling" might not have happened. These include Middle Eastern dictatorships, September 11-style superterrorism, and wars driven by fears of mass destruction weapons.

Several of Mr. Homel's academic brethren (in Australia) have finally gotten tired of putting more lipstick on the Second Law pig. I refer readers to a paper by G.M. Wang *et al.* titled "Experimental Demonstration of Violations of the Second Law of Thermodynamics for Small Systems and Short Time Spans," which appeared in the July 29, 2002 edition of *Physical Review Letters*. Maybe Mr. Homel can tell them what they are doing wrong! —Kevin Varner

Who's Afraid of Albert Einstein?

Your review of the Christopher Bjerknes book, *Albert Einstein: The Incorrigible Plagiarist* (Issue #47), was a big disappointment. Your reviewer, Thomas Phipps, Jr., did not comprehend the significance of the book. Perhaps your politically correct magazine is afraid of Einstein.

Dean Pappas
Tampa, Florida

The Editor Responds: *Infinite Energy*, "politically correct" and "afraid of Einstein"? That's the first time we've heard *that* accusation! Have you not read our "Einstein Reconsidered" issues, beginning with Issue #38, July/August 2001? Have you overlooked our editorial position, which is firmly behind experimentally gathered evidence for an active, dynamic *aether*? Perhaps you misunderstood Dr. Phipps' wry humor and genteel manner, which does not allow for undue focusing on what certainly does look like far less than ethical behavior on Einstein's part in many areas of his life experience. Phipps is no friend of Einstein, that's for sure. That we reviewed the book at all and brought its devastating message about Einstein to a large readership should be sufficient proof that we do not "fear Einstein" or any of his supporters. However, our criticism of Einstein is precise and to-the-point on the most important issue: his physics was—with overwhelming probability—dead wrong. Furthermore, the ascendancy of both Einsteinian relativity theories has grossly set back physics for now almost a century. Matters of Einstein's publishing behavior and personal ethics will become much more prominent and important after the demise of the house of cards that is "space-time," the "twin paradox," "time-dilation," general relativity as an explanation for gravity, and much else. First things first. Correct the prevailing theory, then correct the overblown image of the man. But—stop the press—see Christopher Bjerknes' article in this issue (p. 65). —Eugene Mallove

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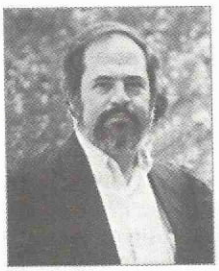
BREAKING THROUGH

The Heretic Life: Publishing Against the Grain

by Eugene F. Mallove, Sc.D.



No one is born into scientific heresy or has it foisted on him. It is a path chosen, based on a *personal* intellectual assessment of what is correct and what is not. When you've chosen to accept some new experimental evidence and associated theory that runs counter to what the current scientific establishment is willing to consider in polite terms, you are a heretic. Your view is not acceptable; it is off limits, beyond the pale, and fair game for mockery by official science. It is most uncomfortable to be a science heretic—whether one has made an original heretical discovery such as did Fleischmann and Pons with "cold fusion," or whether one has learned that certain claimed discoveries marginalized and mocked by the establishment are real—or in some cases have a high probability of being real, meriting further careful examination.

As a heretic, one has fewer friends in the science community and makes many new enemies. To explore this at all effectively, one must necessarily be autobiographical, so I will be. The heretic is generally ignored and on occasion is regarded by less-informed friends with a somewhat puzzled grin that conceals a perhaps unstated deep frustration. Having accepted the difficult mantle of science heresy myself beginning around 1990, I imagine these unspoken impressions among associates who have not crossed over: "Why does such a smart guy, who had such a good education, persist year after year in such a 'foolish business' as cold fusion and other claims of 'free energy'? Why didn't he become something we can all understand: a medical doctor, an attorney, a stock broker—or at least an engineer working '9-to-5' on something respectable like 'death and destruction' (*e.g.* defense contracting), as he did once upon a time?" A quirky thought: Some may view me like the Richard Dreyfus character in the movie "Close Encounters of the Third Kind" (to whom I may bear some superficial physical resemblance), who feverishly shaped Wyoming's Devil's Tower in his living room with hundreds of pounds of mashed potatoes—as he struggled to come to terms with what he had seen? Heaven forefend!

These apprehensions only make the stubbornness of the heretic stronger. The more one learns about the way the contemporary "scientific establishment" works, the more one realizes what a travesty it is in glossing over so many *fundamental problems* at its roots. It is not merely some new allegedly quantum mechanical quirk of loaded metal lattices—"cold fusion"—that needs to be dealt with. The whole edifice and process of science today is rotten to the core—despite its vaunted successes and appearances of invulnerability. Again, this is a personal intellectual analysis, with which even many fellow science heretics may disagree—but there are plenty of thoughtful science heretics who share this view. One then begins to be more generous to other scientific heretics than to those who appear to be cogs in the well-oiled scientific machine of repression and publication "sneer review."

To help overcome this "sneer review," in 1995 I helped found this enterprise, *Infinite Energy* magazine. More recently, the non-profit New Energy Foundation, Inc. (NEF) was born, which supports non-mainstream scientific publishing and research in the area of claimed sources of energy that are truly *new*. Yes, we at NEF are neck deep in heresy.

Just how painful it can be to be a science heretic, was recently brought home in the course of applying to the IRS for 501c(3) tax exempt status—that category of organization that allows benefactors and donors to deduct their contributions to NEF on their U.S. Federal income tax filings. We had to examine a crucial point that would favor NEF: Was "the manner in which the distribution (of the magazine) is accomplished distinguishable from ordinary commercial publishing practices"? For some reason, this arcana for non-profit exemption, coming from an ancient "Revenue Ruling" of the Vietnam era was said to be at issue. It had never occurred to us that *Infinite Energy's* method of publication had to be "distinguishable" from say *Time* magazine or *Newsweek*—it was so obvious that it *was* distinguishable in purpose and in method! I had to review how we had gotten to where we are today. Here's some of that rendition:

"Let me provide some historical background—necessarily somewhat autobiographical—which sheds direct light on our meeting of the criterion. This has to do with the extreme difficulty and in many cases the *impossibility* of getting critical scientific and technological information to those who need to receive it by any other means than by *Infinite Energy*. (Let me note in passing, however, that there are numerous magazine publications within the scientific community that are published by non-profit 501c(3) organizations in a manner that is quite definitely *indistinguishable* in their method of publication from 'ordinary commercial publication practices'; I list and describe many of these in the near final section of this memo labeled 'Other Magazines Published by Non-Profit Organizations with a Bearing on *Infinite Energy*.' However, for the moment let me present here the facts that prove that NEF publishes *Infinite Energy* in a manner 'distin-

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guishable from ordinary commercial publishing practices.'"

Then followed some general background, which even long-time readers of *Infinite Energy* may not know, so please forgive its repetition if you know it: I have advanced degrees in engineering from MIT (SB Aero/Astro Engineering, 1969; SM Aero/Astro Engineering, 1970) and Harvard University School, of Public Health (Sc.D. Environmental Health Sciences, Air Pollution Control Engineering, 1975), and I have worked for various engineering companies in the 1970s and 1980s on national defense, environmental, and energy research areas. In the mid-1980s I began to be interested in writing about science and technology for the general public while I continued my well-paid engineering employment. Eventually, I began to do this science journalism full-time, thanks to the recognition that I received for having published lengthy science pieces in the *Washington Post* and in MIT's *Technology Review*. My first full-time journalism job came in 1985 when I worked as a science writer and broadcaster for the Voice of America in Washington.

In September 1987 I found myself back at my alma mater, MIT, as the Chief Science Writer at the MIT News Office, reporting on MIT's research for the administration newspaper *MIT Tech Talk*, and also promoting MIT's research to the general media. I was happy to have worked up to an almost engineer-level salary when I left the MIT News Office in June 1991. My leaving was to protest what I had discovered in my investigations of the scientific process at MIT on the matter of the discovery that came to be called "cold fusion."

A dozen years later, as Editor-in-Chief of *Infinite Energy* and President of New Energy Foundation, doing far more demanding work, with an intensity and difficulty much greater than my MIT position ever entailed, I make the same salary as in 1991—a sacrifice in itself for the cause of New Energy. What unusual circumstances led a highly trained and valuable scientific person and/or journalist, who might have been earning several factors beyond this 1991 compensation today as an engineer or administrator, to accept in 2003 a completely substandard salary? The answer traces back to March 23, 1989, when an unusual announcement of what became known as "cold fusion" came from the University of Utah by world-class electrochemists Drs. Martin Fleischmann and Stanley Pons. This was the claim that a mysterious "excess heat"—a thermal power release far beyond the bounds of ordinary chemical reactions (and beyond the electricity that was input) was coming from electrochemical cells composed of palladium cathodes and heavy water-based liquid electrolyte. Also, it was claimed that nuclear products were being found in the cells, but with no deadly radiation—*unthinkable* for an allegedly purely chemical system of metal, glass, and water.

I did not, of course, believe that seemingly outlandish claim of Drs. Fleischmann and Pons at first, any more than did any other scientist, until much further checking and confirmation had come in. But as I carried out my duties at MIT, I began to observe something quite puzzling and disturbing: Amid the furor of press reports of confirmation attempts and failures in 1989-1991, I began to see that the evidence was inexorably building up to what looked to me like a large body of supporting evidence for a new phenomenon (or possible new class of phenomena) that might even have world-changing technological implications for a new form of energy that would be extremely beneficial for the environment and the harmony of civilization. But at the same time I noticed that my then friends in the MIT hot fusion program (funded by the U.S. Government to the tune of tens of millions of dollars per year at MIT alone, and to the level of some $17 billion or more *in toto* since the early 1950s), were reacting very negatively toward the cold fusion claims—even accusing Drs. Fleischmann and Pons of "possible fraud" and engaging in "scientific schlock." This, even as positive results of replications came in from around the world! I wrestled with this then puzzling behavior as I wrote my required pieces for *MIT Tech Talk* about what was the reaction of MIT scientists to the Utah claims. By the spring of 1991, I had finished a book, *Fire from Ice: Searching for the Truth Behind the Cold Fusion Furor*, which was published by the major mainstream publisher, John Wiley & Sons, writing work I had been doing on my own time.

Not that I had planned it this way, obviously, but this book led to considerable trouble for me—even though this large, prestigious publisher had nominated the book as one of only two of its works that year for the Pulitzer Prize for non-fiction (ironically, the other one was about Saddam Hussein and oil!). The first thing to happen was that a major cover story article by me about the status of cold fusion (a fair and balanced article), which had been accepted by the then editor and was scheduled to appear in *MIT Technology Review*, was cancelled due to the direct intervention by a person in the MIT Department of Physics who was a strong opponent of cold fusion—*i.e.* the article was censored into oblivion. Other events happened: In reaction to severe disappointments like this I was moved to announce that I had discovered egregious scientific fraud (performed on a Federal contract, no less) on the part of MIT hot fusion people in their so-called "failure" to reproduce the excess heat effect claimed by Fleischmann and Pons. The group had, in fact, found apparent excess heat in its experiment, but one of the sixteen authors on the final report to the U.S. DOE had shifted and manufactured the data to eliminate a positive result. Had this data been properly reported, the entire course of history would have been changed and there might never have been a need for a publication such as *Infinite Energy*. The 55-page account of this travesty is available free of charge in a downloadable pdf file from our website, www.infinite-energy.com.

In disgust and outrage, I resigned my Chief Science Writer position at MIT and spent years in utterly substandard earnings—working at one time as a junior-grade high school science and math teacher in Alton, New Hampshire, as a telephone order-taker for a computer products company in New Hampshire, and in many years making very little money at all because of no secure employment. In fact, for the first two years (spring 1995 to spring 1997) of the publication of *Infinite Energy*, which I and colleagues launched in desperation, because of the news blackout against cold fusion, I had no salary at all. I taught high school and worked as a telephone order-taker just to support the magazine—in other words giving my services for free to keep the magazine going. There are no serious profit-making commercial publications in which an editor, who does virtually all of the work at the magazine (except, of course, writing all of the articles), works for no pay. This was *Infinite Energy* circa 1995-1997.

Infinite Energy, indeed, should have started out as a non-profit organization. We started it as a for-profit, only because

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our "eternal optimism" of those days suggested to us that when more scientists and potential supporters of the research learned the truth about the reality of the newly discovered cold fusion/low-energy nuclear reactions phenomenon, sales of subscriptions would accelerate and we would at least break even—perhaps even become profitable. We were far, far off the mark in that projection! We print a relatively constant 5,000 copies per bimonthly issue and there are now about 1,400 copies purchased of each issue from select newsstands—the rest of the magazines (about 1,300 others) are trashed by the distributor's magazine outlets after not being sold. The regular direct subscribership is in the range of 1,000 to 1,500. Of course, we have our website of free downloadable articles as well, which has a counter that now reads over 370,000 hits; a spin-off exclusively focussed on cold fusion, www.lenr-canr.org, has a large volume of hits too for downloading technical papers and some papers that have originally appeared in *Infinite Energy*.

Still, this is a major accomplishment—especially since the mainstream scientific establishment routinely ridicules what we write about. We have top quality scientists, engineers, technicians, and courageous generalists in our reading audience. People reading *Infinite Energy* may believe that the scientific data and arguments we present are mind-boggling but real—*they are*—but this does not keep the less-than-fanatical devotee in our camp. Most people are impatient: they want to see the Cold Fusion Age (or more generally the New Energy Age) break out as soon as possible and get rid of global gloom and depression. What a wondrous thing to realize that we now have proof that each gallon of ordinary water contains in it enough heavy hydrogen that when fused together to form helium in the cold fusion process—that is the effective result of at least one form of confirmed "cold fusion" process—releases the equivalent of 300 gallons of gasoline. At one time, this secure knowledge was enough to warm this heretic's soul. Now it brings little joy; it seems like just one more astounding fact about Mother Nature over which the tyrannical establishment rides rough-shod.

Here's the fundamental problem with heretical publication—the human attention span in this media-saturated age. Many people are not prepared to either accept or believe that it is worth $29.95 (domestic) or $49.95 (foreign) per year to learn more details about the promises that have not yet been realized in robust technological devices. Of course, when such devices *do* come onto the market after the difficulties have been overcome, every magazine in the world will be forced to write about them and *Infinite Energy* will have served its purpose of helping to usher in the New Energy Age. At that point, the charitable purpose of *Infinite Energy*—to get the whole world thinking and acting about this matter— will have been served. I defy anyone to suggest a conventional commercial publication that has that as a literal goal: Ultimately to put itself "out of business"!

Who do we have to thank for this terrible circumstance that the American/British discovery of cold fusion has been marginalized—pushed to the side, ridiculed, and virtually starved out of existence for research funding? Answer: The scientific establishment, and its mainstream media organs, its lackeys that continue to ignore or disparage research into cold fusion/low-energy nuclear reactions and other forms of New Energy. All this came from the improper behavior of the initial DOE review panel which made its preposterous, unethical rush-to-judgment in the autumn of 1989, influenced of course by vested academic interests in hot fusion and high energy physics such as at MIT and elsewhere. The two leading publications—*Science* (published in the U.S.) and *Nature* (published in the UK)—could turn the entire situation around if they agreed to fairly review and publish scientific articles in this area as we do, but they absolutely refuse to publish anything favorable about cold fusion. They have bought onto the preposterous story-line foisted on the world by arrogant academics at major institutions and agencies that cold fusion is not real, is "pathological science," etc. Since all the other mainstream publications, as well as the general news media, take their cues from *Science* and *Nature*, the expected extreme marginalization of the science has occurred. Therefore, it is up to *Infinite Energy* magazine—perhaps the largest and most respectable of the heretical science publications, which are most often only newsletters not available on newsstands—to attempt to keep alive and increase interest in these remarkable new forms of energy, which would so benefit humankind. That is why our purpose—even in the face of continuing losses that must be made up by contributions from benefactors and donors large and small—is indisputably charitable. No one involved in *Infinite Energy* has any illusions about commercial success as a for-profit publication. No commercial publication on Earth with years of relatively flat sales (but sales at newsstands are now increasing) could afford to keep its doors open. In this regard we have been *de facto* non-profit for years.

Look at what *Infinite Energy* and its heretic allies are up against—big dollars and big influence in the non-profit publishing field. Some easy internet research found this information about influential publications that are demonstrably opposed to or are ignoring cold fusion and other forms of new energy. Let me summarize and annotate what we found:

•***Science Magazine*** (published weekly by the American Association for the Advancement of Science, the AAAS, 501c(3) issued, 1937). This is the largest and most influential circulation journal about science published in the U.S. A subscription is about $125/year—and anyone can subscribe. Its prominent stories are regularly cited by virtually every newspaper and other science publication. (Whatever science subject is not treated by it—"on the fringe," as the mainstream likes to say—is not taken seriously by most other science journalists.) *Science* is very thick and weighty, filled with glitzy advertisements that bring in huge revenues to the AAAS; this certainly makes *Science* indistinguishable, in that sense at least, from almost any other commercial magazine. However, its content includes a substantial number of original scientific publications and review articles discussing those publications—distinguishing it by that technical content from the likes of *Time* magazine, as an example. *Science's* income in 2001 was $84,047,717. Yes, *Science* is huge and powerful and wealthy. It allows the AAAS to have lavish annual meetings attended by thousands of scientists and journalists. Yet, this magazine has had a virtual news blackout about cold fusion ever since the early days of the controversy (1989-90). And in that period it published several scandalous, erroneous attacks against the science, which it has pointedly not retracted. Worse, it refuses to accept for review contemporary articles by cold fusion scientists or to even mention that such technical publications have appeared at scientific meetings and in other technical publica-

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tions in Europe, Russia, China, or Japan. If *Science* magazine were doing its job responsibly with respect to the question of New Energy, there would by no need for a publication such as *Infinite Energy*.

•***Physics Today*** (and many other technical physics publication published monthly by the American Institute of Physics (AIP), 501c(3) issued, 1941). This group of publications has rigorously blocked any reasoned discussion of the matter of cold fusion and many other physics-related New Energy issues. It has a website that for many years has hosted a weekly electronic column by its chief publicist, Professor Robert Park of the University of Maryland, whose column brings scathing ridicule against all who have been involved in cold fusion and the quest for New Energy. Park is regularly interviewed by other high-profile general news media, so his views about physics and many other matters—space exploration, missile defense, etc., unfortunately dominate public discussion. The income of AIP in 2000 was $77,236,350. The magazine excludes reasoned discussion of cold fusion and other New Energy. *Infinite Energy* must try valiantly to buck the tide of negativity generated by the AIP and the AAAS—two non-profit organizations that are not living up to their charters in the strictest sense.

•***Science News*** (published weekly by Science Service, Inc., 501c(3) issued 1922). This is a thin, but large circulation magazine that is highly influential among science journalists. It offers journalistic summaries of scientific work that is published by *Science, Nature, Physics Today,* and many other technical journals. Its income in 2000 was $11,620,843, making it a very powerful media outlet for science information. In the mid-1990s, when *Infinite Energy* was trying to get on its feet, we attempted to place an ad for our publication in *Science News*. The ad representative was delighted to help us get the ad ready for publication, but when the *Science News* editor-in-chief found out that we were a publication that treated cold fusion seriously, she rejected the ad. We were not allowed to advertise in *Science News* no matter what the ad said! Indeed, *Science News* does not cover cold fusion or other New Energy issues.

•***American Scientist*** (published ten times/year by Sigma Xi, The Scientific Research Society, 501c(3) issued, 1943). This publication is particularly galling to me. I happen to have been elected to this Sigma Xi Society when I obtained my engineering doctorate from Harvard University School of Public Health. In this publication, which is excellent in many respects in reporting conventional scientific findings, you will look long and hard to find any mention of observations that are outside the mainstream paradigms. In fact, they have published at least one scathing attack against cold fusion, calling it "pathological science." Even more egregious and astounding, several years ago this publication, like *Science News,* refused permission to *Infinite Energy* magazine to advertise in its pages. [Annual income, 2001, $7,280,225]

•***Catalyst*** (previously called ***Nucleus***) (published by Union of Concerned Scientists, 501c(3) issued 1974). This journal talks about energy and the environment, as *Infinite Energy* does, but this journal has *never* to our knowledge published an acknowledgement in any form that there are sciences and technologies that go beyond solar power, wind energy, and the like—*i.e.* New Energy. Furthermore, though this journal has talked about high-energy transmutation of nuclear waste as one method of disposing of it, it refuses to acknowledge or mention that there are now low-energy nuclear reaction methodologies that have been tested which should be considered in dealing with the nuclear waste problem. [Annual income, 2001, $8,834,439]

•***E The Environmental Magazine*** (published bi-monthly by the Earth Action Network, Inc., 501c(3) issued, 1990). This journal talks about energy and the environment, but it has never to our knowledge published an acknowledgement in any form that there are sciences and technologies that go beyond solar power, wind energy, and the like—*i.e.* New Energy. In fact, a colleague friendly to *E* and to *Infinite Energy* asked *E* to cover some of what we write about, and *E's* editor refused. [Annual income, 2001, $748,436]

•***Earth Island Journal*** (published quarterly by the Earth Island Institute, 501c(3) issued, 1982). This journal talks about energy and the environment, but it has never to our knowledge published an acknowledgement in any form that there are sciences and technologies that go beyond solar power, wind energy, and the like—*i.e.* New Energy. [Annual income, 2001, $4,548,330]

•***Worldwatch*** (published bi-monthly by the World Watch Institute, 501c(3) issued, 1974). This journal talks about energy and the environment, but it has never to our knowledge published an acknowledgement in any form that there are sciences and technologies that go beyond solar power, wind energy, and the like—*i.e.* New Energy. [Annual income, 2000, $4,028,674]

•***Bulletin of the Atomic Scientists*** (published bi-monthly by the Educational Foundation for Nuclear Science, 501c(3) issued, 1950). This journal talks about energy and the environment, but this journal has never to our knowledge published an acknowledgement in any form that there are sciences and technologies that go beyond solar power, wind energy, and the like—*i.e.* New Energy. Furthermore, though this journal talks about high-energy transmutation of nuclear waste as one method of disposing of it, it refuses to acknowledge or mention that there are now low-energy nuclear reaction methodologies that have been tested which should be considered in dealing with the nuclear waste problem. [Annual income, 2001, $1,145,424]

•***Skeptical Inquirer*** (published bi-monthly by the Center for Inquiry, subgroup Committee for the Scientific Investigation of Claims of the Paranormal—CSICOP, 501c(3) issued, 1976). This highly influential organization actively attacks, usually by mockery and borderline slander, any and all suggestions that our present foundational scientific theories may be in need of significant modification. They have attacked low-energy nuclear reaction research, Dr. Randell Mills' theory and experiments in Classical Quantum Mechanics, various electromagnetic devices with claimed excess power characteristics, and anti-gravity experiments. All of these *Infinite Energy* covers objectively, with an open view about the validity of this or that experimental confirmation. [Annual income, 2000, $1,076,565]

So, this is the publishing opposition we heretics face, all funded by tax-exempt "non-profit" organizations. *Infinite Energy's* purposes and activities are similar to these cited publi-

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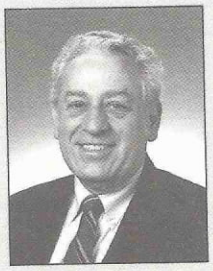
cations. It has a particular set of editorial viewpoints as these publications do, a view that is at odds with prevailing published information, because we believe we are at the vanguard of publishing information about a scientific revolution in progress. Our viewpoint primarily deals with the question of energy and the environment, but from the perspective that there are radically new forms of energy and science that will help us address more effectively the very problems that these other non-profit publications bemoan. These other publications ignore or attack the science and emerging technology that we discuss. Our purpose is to educate and to clarify, which is precisely what these other publications are doing in their own obstructionist and sometimes unethical way. *Infinite Energy* keeps scientific and other information flowing to New Energy researchers and interested citizens in over forty countries, despite its present small circulation. Our other activity is to seek funding that can be disbursed, in the form of scientific grants to woefully under-funded researchers who are not privileged to have the largess that government and some lavish non-profit groups grant to decidedly mainstream energy and science research. In the above listing of non-profit publications, we have not mentioned the many other mainstream environmental groups, annual donations to which total $1 billion or more, and none of which show the slightest interest in New Energy. They have their publications too.

Since the topic of New Energy science and technology, which we believe is of overarching importance to human welfare, is being unfairly treated, it is our objective to bring truth and light to the subject. This is heretical scientific publication against the grain, a very tough path to be on these days. ❑❑❑

Dr. Marcello Truzzi (1935-2003)
Scourge of the Pseudoskeptics



Dr. Marcello Truzzi, a long time friend of *Infinite Energy*, who was a scholarly sociologist of the process of science and the investigation of scientific anomalies, died February 2 after a long battle with cancer. He had been a Professor of Sociology at Eastern Michigan University. He resided in Grass Lake, Michigan and was the Director for a group based in Ann Arbor, the Center for Scientific Anomalies Research. He was also a long-standing member of the Society for Scientific Exploration.

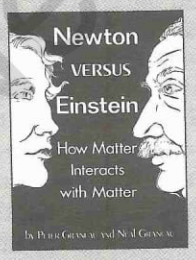
In the early 1970s, Truzzi founded a newsletter, *The Zetetic*, at Eastern Michigan University, whose focus was examining claims of what are generically called "paranormal" phenomena. It was later re-named *Zetetic Scholar*. But Truzzi's passion was the more all-encompassing study of the reaction of society to anomalous phenomena such as cold fusion. I met Marcello in 1991 when he called to seek my opinions about cold fusion. He was one of the early signers of a petition we circulated to the U.S. Congress to re-open an investigation into the phenomena that the DOE had so quickly dismissed.

A remarkable twist in the biography of this former stage magician turned academic (with a family background of circus performers!) came in 1976. He was asked to co-chair the newly founded Committee on the Scientific Investigation of Claims of the Paranormal (CSICOP). Marcello had thought that the purpose of the group was to openly and fairly investigate paranormal claims and other scientific anomalies. He separated from CSICOP in 1977, he told me, when it became clear to him that it was heading strongly in the direction of being an advocacy debunking society.

As Paul Kurtz, CSICOP's chairman, recalled (*Skeptical Inquirer*, May/June 2003), "He wished our new Committee and its magazine to include both 'believers' and 'unbelievers,' but the Council thought that there were literally hundreds of magazines and groups worldwide devoted to the pro-paranormal viewpoint, while almost none were interested in exploring a skeptical scientific agenda." The claim by Kurtz that CSICOP has a skeptical scientific agenda is baloney, as Truzzi and many other observers of CSICOP's agenda of debunkery at all costs had determined. Whether its journal, *Skeptical Inquirer*, admits it or not, its iron-clad doctrine is to adhere in its sham "investigations" and polemics to what the current scientific establishment believes is possible and what is impossible—experimental data to the contrary be damned. Its position on cold fusion, as an example, ranges from egregious mockery to benign neglect—willful ignoring of the now overwhelming scientific evidence published in peer-reviewed and non-peer reviewed journals. Kurtz's obituary for Truzzi, true to form, marginalized him as "the skeptical gadfly."

Marcello Truzzi wrote in 1989: "Over the years, I have decried the misuse of the term 'skeptic' when used to refer to all critics of anomaly claims. Alas, the label has been thus misapplied by both proponents and critics of the paranormal. Sometimes users of the term have distinguished between so-called 'soft' and 'hard' skeptics, and I in part revived the term 'zetetic' because of the term's misuse; but I now think the problems go beyond mere terminology, and matters need to be set right. Since 'skepticism' properly refers to doubt rather than denial—non-belief rather than belief—critics who take the negative rather than an agnostic position but still call themselves 'skeptics' are actually pseudoskeptics and have, I believe gained a false advantage by usurping that label."

We shall very much miss such wise counsel from Marcello, whose enthusiasm was infectious and whose encyclopedic knowledge of anomalistics and its intrigues was remarkable.



Hardcover, 219 pp., Published 1993

Newton Versus Einstein: How Matter Interacts with Matter

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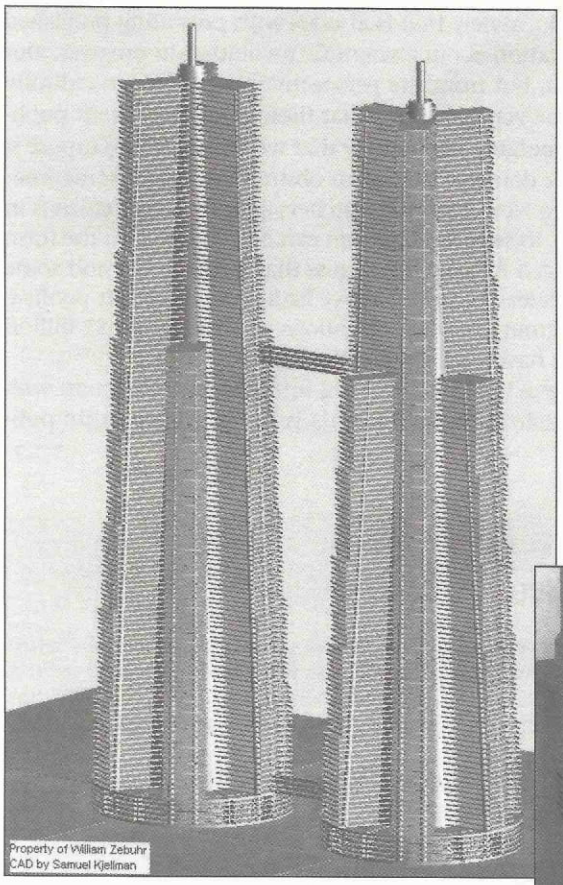
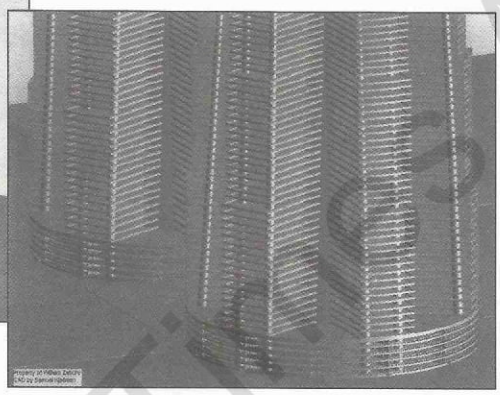


Defiance Rising— Super-Tall and Ultra-Secure Buildings:

Energy Efficient, Life Enhancing Real Estate in the Sky

Bill Zebuhr*



Every civilization in its time develops its character in art, architecture, and construction in ways that shape the patterns of its life. Culture and belief are woven into these patterns, which reflect an understanding of the laws of nature that form the fabric of that civilization. But civilizations are also sometimes changed in a revolutionary way by the emergence of transformational technologies. Civilizations naturally select and apply technologies that are perceived to yield a higher quality of life and a greater projection of power.

The discovery of geochemical oil as an energy source has arguably been one of the most transformational technologies in human history. It has led to the virtually unlimited expansion of human ability to shape and form the environment. Though the Oil Age has brought intense development, at the same time enormous inefficiencies have developed, because energy has been relatively inexpensive; until recently, there has not been much incentive to improve. But the Oil Age is coming to an end, and there is now a chance to reconfigure and reinvent our urban infrastructure. We can transform the fabric of urban life with more wholesome and sustainable patterns, while boosting the health and productivity of city-dwelling people.

I would like to propose a vision for the redesign and reorganization of urban infrastructures that could achieve a very large increase in energy efficiency and the quality of life. This vision centers around a specific building design, which evolved from a paradigm-shifting concept for super-tall, terrorism-secure buildings. But our main purpose is to stimulate breakthrough thinking among those who will design and build our future cities.

There are many benefits to a large population engaged in close proximity in an active economy, but this economy must be sustainable. Our current urban economies and our world economy are not sustainable and are getting less so. Vast natural resources are wasted, but the single biggest resource that is wasted is *human* energy. Perhaps new sources of energy based on paradigm-breaking physics will emerge, but while we await this "New Energy Age," it would be good to see what we can do *now* for the benefit of conserving energy, and especially *human energy*, which would continue to be wasted even in a New Energy Age, if urban design is not better planned. A properly designed urban environment has the potential to greatly reduce resource consumption to yield a sustainable economy, while providing a very high quality of life.

"Quality of life" may be defined differently by diverse people, but a majority would surely agree on this: a clean, secure environment where privacy is respected but high quality human interaction is facilitated and the effort to sustain this life is minimized. Clean means clean air, water, earth, and general living environment. Secure means minimizing risk from natural events, criminal activity, and accident. Quality human interaction is facilitated by ease of physical access to large numbers of people who can enhance one's life. Minimal effort means low living costs and minimum use of time to sustain a quality private space within the environment. A personal private space must be able to reflect the vast range of individuality in society. The space must be able to be sized and configured by the owner or occupant.

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The best parts of the best cities provide some of these qualities, small towns and suburban areas provide others, but none combine the benefits of these different environments and none do it in a sustainable way. A large part of the reason for this failure is that today's physical society is based on traditional ideas and old technology. We can do much better with what we know today, but it will require a more radical departure than is usually considered, combined with the appropriate use of all available technologies and our best knowledge of the nature of people.

A well-designed urban environment that is a mix of high density and open space can provide all of these qualities for the great majority of people, while also leaving most land open for the natural environment to prosper and for the remaining population that would not be happy in an urban environment regardless of its' quality or that wants to engage in land-intensive activities like farming.

Well-designed tall buildings enable the high density by opening up the vertical dimension for efficient, secure use. Today's tall buildings are not nearly as secure as they could be and fail to offer the kind of high quality space that is potentially available. They also are not considered as part of a well-integrated system of infrastructure and other buildings, so that much of their potential is wasted. Typically, transportation links are marginal, the building has limited views and access to light due to others that are too close or aligned poorly, there is little or no access to outside space, and flexibility of use is too limited. It is also vulnerable to accident or attack—as September 11, 2001 showed—and little or no consideration is given to minimizing overall energy use and other elements of sustainability. The costs of building and maintaining the space is high due to high costs of infrastructure within the current urban environment. Most of this expense is due to general inefficiencies and the high cost of government.

The Infamous Grid

In a typical city today the street grid is the biggest barrier to efficient operation and high quality of life. Except for subways, the street grid is the only means of horizontal transport. In most cities cars are considered necessary because the alternatives are so poor. The grids in use today are essentially the same as in ancient Rome. They were designed to accommodate modest density and transport by foot and animal power. Buildings were small and transport slow, so the grids were small and streets narrow. The streets have become wider and grids expanded somewhat, but the whole system is not adequate for a dense city with large numbers of people and vehicles sharing essentially the same space. Streets now take up a large proportion of urban land. They are expensive, dirty, noisy, and grossly inefficient. They interfere with the ability to build proper tall structures that could be the backbone of a new urban infrastructure. Buildings today are not considered an inherent part of the infrastructure. They are considered temporary structures within an infrastructure and as such they are built around the infrastructure as after-thoughts. They are also built essentially the same way as they were centuries ago—a basic post and beam structure for most city buildings. This is a good, flexible, well-known and cost effective system, but has limitations in the larger structures that could be used to make a much better urban environment.

I propose that a city is better thought of as a space with a three-dimensional grid instead of a two-dimensional grid, with buildings being a major element of the infrastructure. This allows the whole infrastructure to work in harmony to take better advantage of the dimension of height.

I have started with the buildings, since they are the vertical element and less flexible in design than the horizontal grid. This is the opposite from normal planning. The optimum height is a function of many things but is mostly driven by cost trade offs. It is more expensive per square foot to build higher, but then the horizontal dimensions required are less for a given population. A large city, of course, can justify taller buildings, but a city doesn't really have to be very big to justify buildings as tall or taller than the present tallest buildings on Earth!

A Super-Strong Cone at the Core

One of the most precious commodities in a large building is natural light. Natural light means nearness to a window and implies a view and lower lighting costs. A tall, secure building tends also to be wide so that care must be taken to provide good access to windows. Also, surrounding buildings must not excessively block light and view. To accomplish this, a large city of 500,000 people or more might consist of clusters of buildings surrounded by open space and all arranged to maximize light and view. In the Northern Hemisphere sunlight comes from the south, so a cluster might be organized with the highest buildings to the north, so that they don't shade the lower ones.

In this example, which I have subjected to analysis for its structural integrity, the highest buildings are 150 floors or about 1,900 feet high. The core of the building is a truncated cone 260 feet in diameter at the base and 70 feet in diameter at the top. The cone is made of reinforced concrete with walls about six feet thick at the base and three feet thick at the top. The cone houses most of the elevators and other equipment and some floor space that does not need access to view and natural light. Most of the floor space is contained in the radiating structures that extend outward from the cone 100 to 150 feet or so. These might be about 100 to 130 feet wide at the base and diminish toward the top. There could be six rays symmetrically spaced around the cone (as shown in graphic on page 1). Perhaps two thirds of the way up, three of the rays might end and three would go all the way up. About one half of the weight of each ray is held by the cone and the rest by columns. The total floor space of such a building could be 6,000,000 to 8,000,000 square feet net, which would make it by far the largest in the world as well as the tallest. By comparison each tower of the World Trade Center had about 4,000,000 square feet.

A building this big has a lot of advantages, as will be seen, but it must not collapse under any known circumstances (short of destruction by a nuclear weapon or asteroid impact). This proposed design, which is covered under a recent patent application, has several design features that make it very secure and virtually eliminates any chance of a total collapse. First, the cone is extremely strong and provides a safe haven from any floor. Each floor of each ray has access to and from the cone. The elevators are against the cone and open inward. The size of the building is to a large degree suggested by what is the minimum strength and mass that the core should have. It is designed to survive any impact or explosion thought possible.

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Second, each ray is like an independent building, so that the total collapse of any ray will not cause either the cone or any other ray to collapse. Third, each ray is designed so that a structural failure will not cause a cascading failure that brings down the whole ray. Floors and columns are designed to collapse in an organized way once failure has occurred. Part of the structure below the collapsing structure becomes a barrier that sheds the collapsing structure and prevents the cascade. Figures 1 and 2 from the patent application show the general idea.

Many variations of these features are possible in practice, but in any of these a massive core is necessary, which becomes the infrastructure of the vertical dimension and in turn suggests the plan of the city. In this example the cone is 260 feet in diameter at the base with rays extending 120 feet in each direction, making a base width of 500 feet. See Figures 3 and 4. This will not fit in a normal street grid. A 700-foot grid is suggested here as an example. In many cases only one massive building would be in each grid section. The spacing allows good light penetration and views, which in turn allows the creation and use of quality "outside" space. The cones or cores are part of the infrastructure grid, but floors are the true real estate—"real estate in the sky." To make it attractive, the building should have a good "location" that has light and a view, access to infrastructure, and can be developed in a wide variety of ways to suit a multitude of uses and customers.

Any given ray of the building can be fairly narrow to give good access to windows. Good light access also allows plants to grow. Ideally, much of a building's perimeter could have planters to create extravagant sky gardens. Typical tall buildings are sealed, but these could have perimeter walkways at any level and some of these could open to become outside space forming sky sidewalks, parks, and plazas (Figure 5). If this were done to the full extent in the 1900-foot building it would have about forty miles of walkway and over eight acres of green space including roofs. Thus the building, covering less than five acres, could support much more green space than the original ground. The view from a high vantage point down on the city would be more like a mountain garden than the bleak sea of black roofs and equipment visible from above in cities now. A person looking out of their condominium on the 110th floor might look through the sliding glass doors to an outside plaza bordered on the outside by a three-foot wide planter with flowers, shrubs, and even small trees. The cone would be like a secure mountain behind them. The view would be varied, open, dramatic, and pleasant. The edge of the cluster might be half a mile away followed by almost a mile of open park and recreation land with another cluster of tall buildings beyond. In a commercial section the outside plaza would be a skywalk lined by shops. In an office section there could be places to go to relax or walkways to other areas. This example building could have all of these sections and more. It could provide living space for 10,000

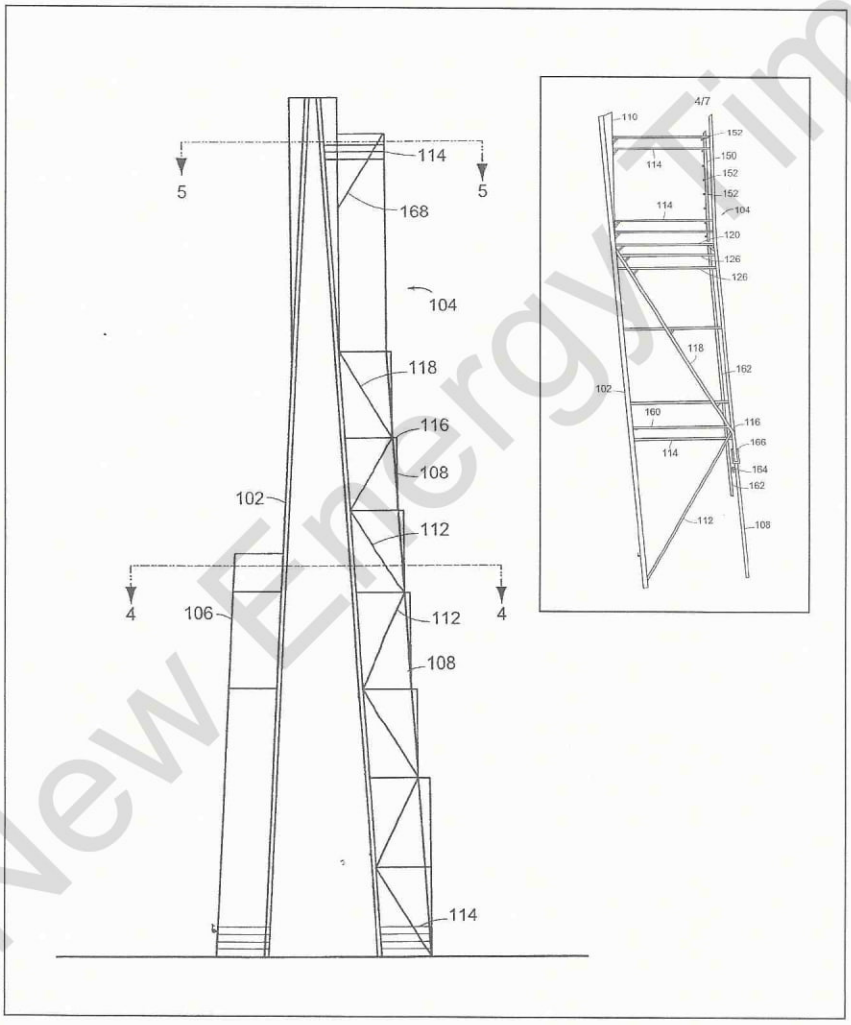

Figure 1. Overview of part of frame and more detailed partial view near top.

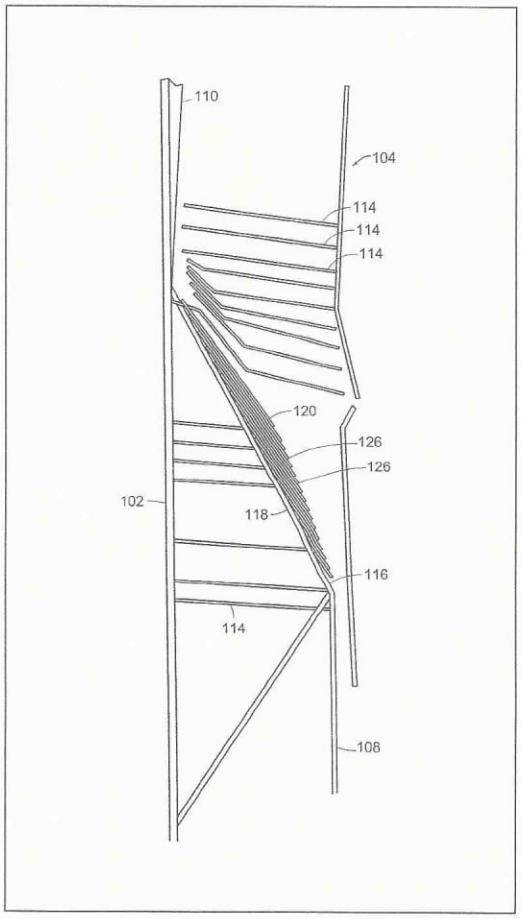

Figure 2. Partial collapse in progress where a barrier prevents a cascading event.

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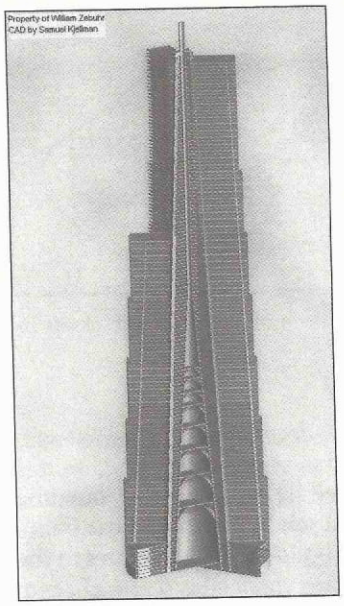

Figure 3. Section view showing large spaces inside cone.

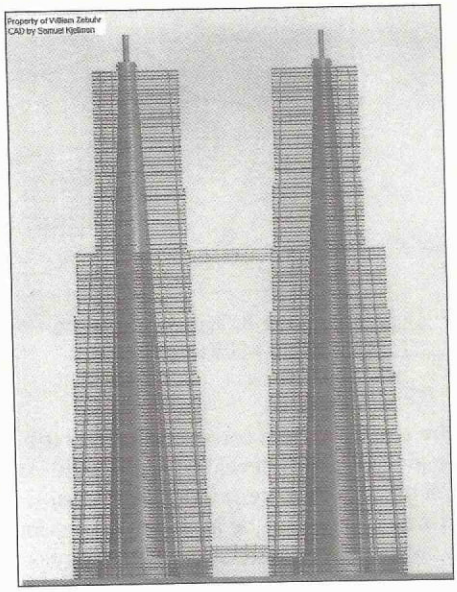

Figure 4. Cone showing through glass walls, 150 floors.

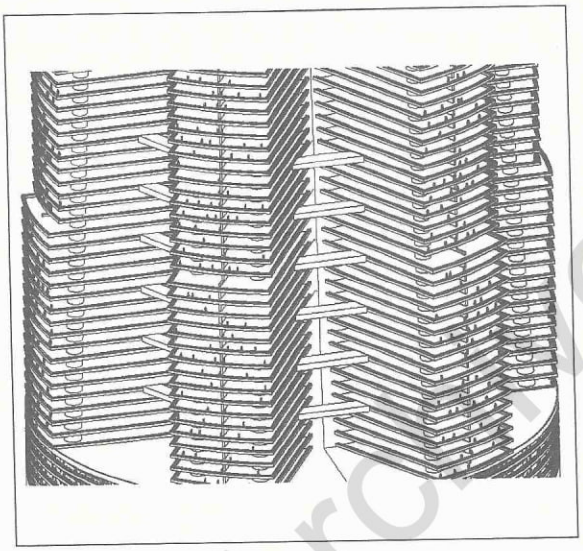

Figure 5. Sky terraces between rays.

people plus their shopping space, schools, and workspace. Thus, each large building could be a fairly complete community but it would take many of these buildings to make a true city. They would be connected and serviced by the intra-city infrastructure of streets, mass transit, walkways, and utilities.

Conserving Human Energy

In this example, the 700-foot by 700-foot grid contains streets that are below grade and partially covered. The main grade is reserved for pedestrians and a mass transit system, which could be a variant of a light rail system, but it would consist of small, lightweight, quiet cars traveling at fairly low speeds and making stops near each grid crossing. The perpendicular streets and rail system would be at different levels to avoid stopping at intersections. The streets would be ramp connected for right turns only (three right turns to make a left); no traffic lights or stop signs would be required. Distances are short and speeds could be low. The roads are for the exceptional needs, not the general needs—these would all be dealt with by the mass transit system. The mass transit system would be walk on and off without steps. Everything would accommodate wheeled vehicles so that wheelchairs and small goods are easily handled. Special rail freight cars and trucks would handle most freight.

Most travel within a cluster would probably be by elevator or foot. Distances would typically be less than one half mile. Links between buildings would be at multiple levels. These would be footbridges or could be moving sidewalks and/or a very light pod type transit system (Figure 6). The exact type of transport is not critical; what is important is that distances are short and transport is quick, safe, low effort, and low cost. The typical commute to work would be an easy ten minutes or less. In a city of several million with five or six clusters in a park setting, a person could get from any point to any other in about twenty minutes with or without a car (Figures 7-11). The savings of time, money, energy, and frustration would be huge. Efficient transport affects almost every aspect of life, from commuting to parcel delivery to trash collection.

Large, properly designed buildings in this environment could reduce overall energy use by over 80% versus that of the typical situation. A large building is essentially free to heat since heat from normal lighting, people, equipment, etc. will do the whole job. Tall buildings with good solar control can be efficient to cool and the centralized equipment can be highly efficient. Electricity would be generated locally by co-generation so that water heating would be a virtually free by-product.

A significant portion of the electricity used could be generated by wind power. Wind generators would be strategically placed between buildings where wind would be funneled through, not only to produce power, but to temper the wind velocity. This would only be done in places where the generators were unobtrusive. Photovoltaic arrays to produce some power could be placed on areas of south-facing walls that were not windows.

Recycling and trash collection would be clean and efficient and result in much less waste. A lot of packaging could be directly reused due to ease of transport and high density.

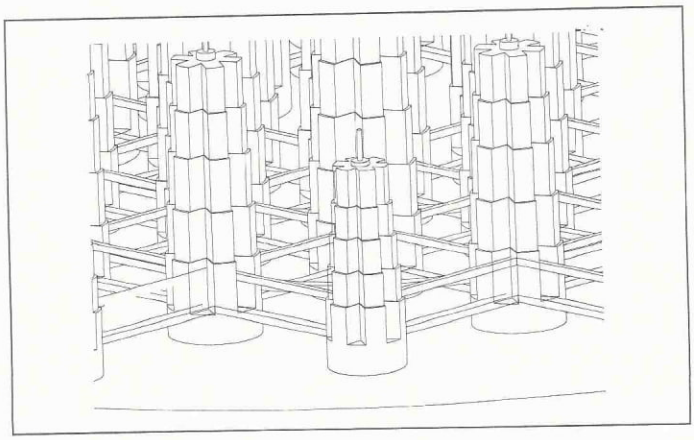

Figure 6. Transportation links for pedestrians and small vehicles.

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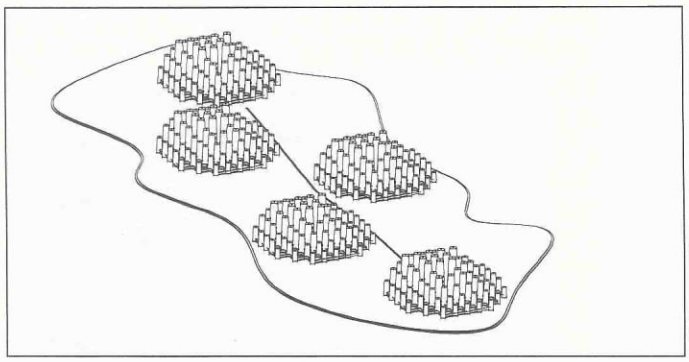

Figure 7. Overview of city of two to three million.

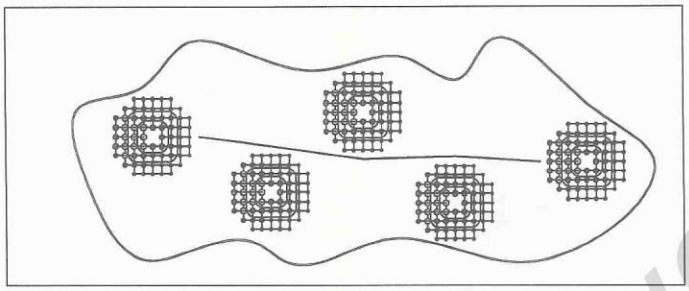

Figure 8. Top view showing single linking of clusters. Each cluster is about 1,000 acres.

Water consumption could be greatly reduced due to the ability to treat and recycle water in each building. Sludge along with garbage could be composted on the site, so no central sewage treatment plant would be needed. Rainwater could be collected to add to the water supply. Technically, water consumption could be reduced by 90% or more with no sacrifice of comfort by efficient use and recycling. This city could get its water from its own water shed.

The buildings in a cluster might range in size from, in this example, 150 stories and 8 million square feet to 50 stories and 1 million square feet. Smaller buildings would not be strong enough to meet the self-imposed security requirements (they could be knocked down too easily) and they would reduce the effectiveness of the transportation system, heating and cooling, water, sewage, and solid waste handling. A one million square foot building is very big by normal standards, but with the cone and ray design, each ray can be considered an individual building, so a one million square foot building with six rays could be thought of as six 166,667 square foot buildings, which are small buildings for a big city. Each of these could be further compartmentalized by height if desired, but they would all take advantage of the cone core as part of the infrastructure.

In a conventional city the initial developer is concerned with land development, including the street and utility grid. In this case he would also consider carefully what kind of building would be in each grid section and might even build the building cores and let other developers build the ray structures to the requirements of tenants. The cores, preferably cone shaped, become part of the landscape and the rays are like buildings built into a steep mountainside. The cost of going vertical is offset by the reduced horizontal dimensions and greatly increased overall efficiency. The economic trade-off is very much in favor of height, but that isn't realized in most cases because of the infrastructure that already exists which is a sunk cost, complete with all its gross inefficiencies. The cost of the structure of a building is typically about 20% of the total cost. In these structures it might be 30%, so the net cost of building very tall is not as much as might be supposed—about 10% of the total building cost and allocated to infrastructure cost. The net effect is that the total cost of the city is less.

A New Urban Life

In conventional construction, elevators tend to take up a large part of the lower floors of a tall building. That is a serious constraint when limited to a given lot dimension, but with a tapered building that is allowed to have a wide base, this is not a problem. Elevators become a larger part of the whole transportation system and their cost is more than off-

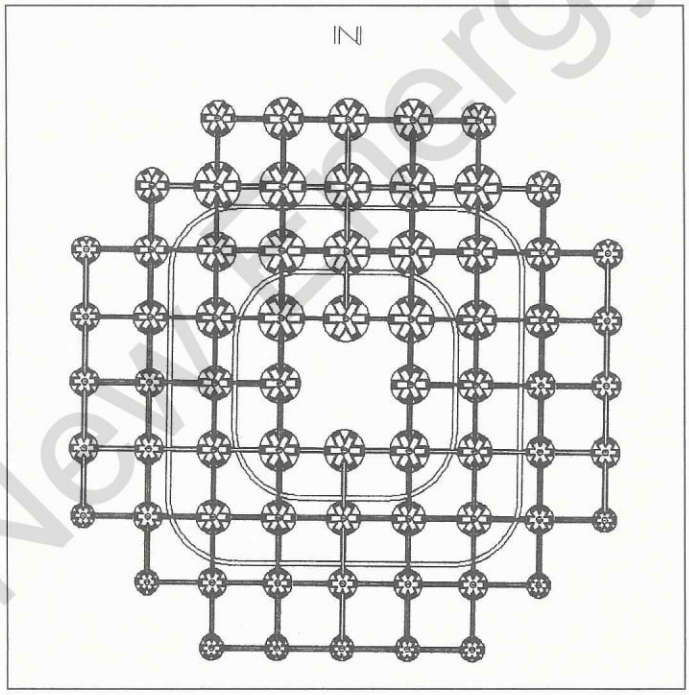

Figure 9. Top view of cluster 700 foot grid.

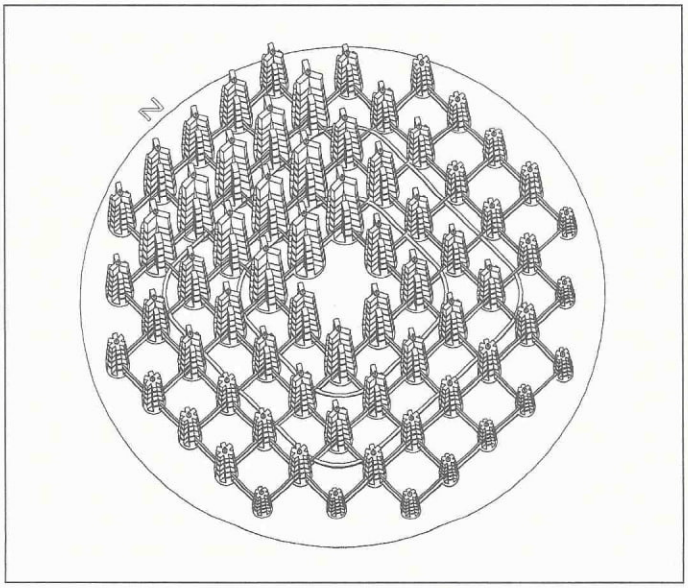

Figure 10. View from southwest; note good sunlight access.

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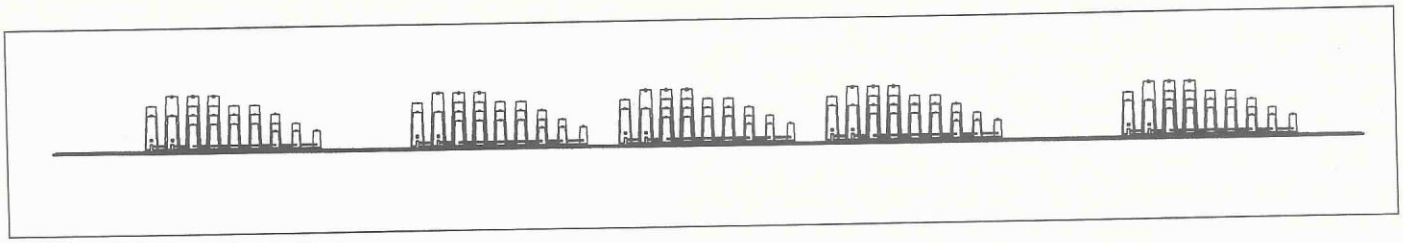

Figure 11. Side view of large city.

set by the reduction in the horizontal system. Large multi-use buildings reduce even the need for elevator travel, because the building itself is much more self-sufficient. Other costs are also reduced by the size and multiple use. A single building might have a large variety of tenants and owners. In the 150-story example, there might be 2,500 condominiums and apartments with 10,000 total occupants. If the average size was 1,800 square feet, the total is 4,500,000 square feet, leaving 3,500,000 square feet for offices, schools, light industry, restaurants, a hotel, shopping areas, a concert hall, medical center, gymnasiums, and parking as well as space for an onsite power plant, water and sewer treatment plants, trash collection and recycling center, a community center with police and fire station, and whatever else might be desired. The building is like a town and could be managed as such. The town is a nice manageable size and a good community; the problem is it is not big enough to have many of the things a city would have. But when there are four other towns only a few hundred feet away and over 100 within a ten-minute walk, life could be very interesting. The best restaurants, the best art, music, museums, schools, sports, etc. are easily available and so are many good jobs. Even the open spaces of the surrounding park land, which is easily visible from anywhere in the city, is accessible in ten or fifteen minutes, even by walking. Life can be rich and easy, even without a lot of money.

The example average condominium was 1,800 square feet, which may seem small especially compared to some upper middle class suburban houses, but in the city less can be more. You don't need a car—rent one any time to go on a trip but no need for one on a daily basis. You don't need a lawn mower, tractor, tiller, snow shovel, etc. You don't need a fancy entranceway, because the building has a grand entrance that would make yours look silly. You don't need a large guest area because there is a hotel with low rates for building occupants a few floors away. You don't need a fancy home entertainment room, because there are plenty of much better facilities available a few minutes away. The living room of the condo would be looking out over the city toward the park as almost any view would because the park surrounds the city and the buildings are spaced for light and view. The view also looks out over some beautiful roof top gardens and greenhouses on other buildings that are in the foreground, but none close enough to interfere with privacy.

Privacy is probably the most important element of individual space and would be more secure in this city than in the typical suburban setting. The residents would have a large window area (if desired), but the living area is set back to provide outside space and reduce the height sensation. The setback also shades the summer sun and helps prevent people from seeing inside due to the shadow effect. Outside planters can selectively block views, but the biggest advantage is distance. The space between buildings would be much greater than the space between houses on a typical suburban street. Another important aspect of a residence is freedom of self-expression. In this case once a person acquires real estate (floor area) they have a wide range of options to develop or build on it. This is mostly due to the ability to allocate inside and outside space and the variety of different shapes and exposures of space made available by the ray structure. The residence could be fully exposed on the outer corner of a ray with large open patios and gardens or could be on an inside corner with little or no outside space. Outside space is floor space that can be opened to the outside. The building would have an inner and outer curtain wall mostly of glass. The outer wall could open to make the area between walls an open patio (with a roof). The planters would be along the outside wall to get full available light and block access to the edge, which of course would have a safe railing system. The inner wall would have doorway access to the out space.

A wealthy person might have a multimillion dollar estate covering several thousand square feet with a large outside space two stories high, having large planting areas with flowers, bushes, trees, and a vegetable garden. It could be on the southeast corner and have excellent access to sunlight. A person of modest means might have a 500 square foot efficiency with a small outside porch area that would cost well under $100,000. The people who work in the hotels and retail jobs should be able to afford to live in the same building if they want to. All would benefit from the efficient infrastructure and great security.

Safety and Security

Security from criminal behavior would be handled in conventional ways, but response would be much faster, since each building could support a few police if needed. A police officer could be virtually anywhere in less than five minutes, usually less than one or two. Various sections of the building would have different kinds of limited access like society in general, but in this case it would be more easily enforced due to well-defined access means and natural division into rays and floors. The buildings are designed from the ground up to be secure against catastrophic structural failure, which means the normal accidents such as fire in an apartment would be very easily dealt with. In the worst case the safe haven of the cone is available in seconds from virtually anywhere. There would also be other even more secure sanctuary areas within the cone that are a natural result of the structure that would be available. The size of the structures is part of what

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makes them secure, and the rest is a design uncompromised by conventional constraints. There is no comparison between the safety of this city compared to a conventional one. No building in this city could be knocked down by an airplane, but almost any building in our cities today could be destroyed in seconds by the same event.

This city concept offers huge advantages in quality of life, security, and cost, so much so that if practiced widely our world population could live at high standards of sustainably. Of course, the opportunities to build cities from scratch are rare to non-existent, but the concepts could be implemented at great benefit on an opportunistic basis in existing cities. A poorly used or abandoned site such as a brown-field site could be developed with one or more large structures. They would be large enough to be somewhat self-sufficient communities that could be expanded upon as conditions allow. A second cluster elsewhere in the general area could be connected by a special transportation link, maybe just shuttle buses at first, but as other buildings were added, the general density of the area would increase and efficiencies would be increased. In the meantime, the erection of even a single large building of this design could demonstrate the efficiencies and quality of life. It would attract many new people to the area. This could usually be done only if no existing infrastructure existed or if the city was willing to modify the existing grid. None of this would require that more money be spent on buildings or infrastructure, it just requires that money already being spent be better coordinated and concentrated. The result would be a profound reduction in the use of energy and other resources and a huge increase in the productivity and joy of people. ❑❑❑

Application to the World Trade Center Site

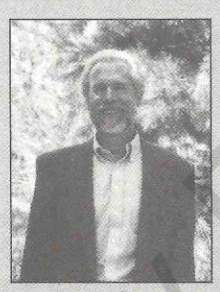
My belief in the need for efficient green cities is a result of observing the destruction of the landscape by ugly urban sprawl with its waste of resources and the frustration and waste of time dealing with it. Some of the structural ideas, however, were a result of reflecting on the collapse of the World Trade Center. It is always possible to have a structural failure, but it should not take down the whole building. The cone-ray structure with its cone core, sectional construction, and built-in provision for stopping cascade effects from a failure was the result of an effort to design a structure very resistant to catastrophic failure.

Twin Towers of this general design, taller and larger than the originals, 150 stories at 1,900 feet, would be a fitting memorial. It would be a memorial that would show the world that we can rebuild bigger and better, where bigger means safer and means bringing in a whole new community into Lower Manhattan. It could be a mixed use 24/7 community with green space coexisting with occupants and visitors—something that people live with, not just visit. It could be so attractive as a community that it would create its own reason to exist by bringing people into the city.

The cone cores could be built, at least partially, over the original sites and a quiet cathedral-like meditation space could be inside, which extended all the way down to the true Ground Zero, the foundation rock of the original buildings. The buildings and the new community is the memorial. The meditation space would pay quiet tribute to the victims. —WZ

About the Author

Mr. Zebuhr is founder, CEO, and CTO of Ovation Products Corporation. Ovation Products is developing and selling a revolutionary water treatment system that operates by vapor compression distillation. He has been a founder of three other companies. At Des Champs Labs he was co-founder and the Chief Engineer of the Z-duct heat exchanger, which became the largest selling heat exchanger of its type and has been instrumental in saving hundreds of millions of gallons of oil. At Sunhouse Mr. Zebuhr was CEO and the designer of solar hot water and geothermal cooling systems. He was also founder, designer, and CEO of American Thermal. The company developed a pressure-less hot water tank with a unique pump that used the pressure of the incoming water to re-pressurize the water out of the tank. Mr. Zebuhr also has extensive experience in designing military hardware. He has a B.A. and M.A. in mechanical engineering from Cornell University and holds 25 patents.



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Four Paradoxes Involving the Second Law of Thermodynamics

D.P. Sheehan*

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Abstract

Recently four independent paradoxes have been proposed which appear to challenge the second law of thermodynamics.[1-12] These paradoxes are briefly reviewed. It is shown that each paradox results from a synergism of two broken symmetries—one geometric, one thermodynamic.

Author Note

This article was first published five years ago in the *Journal of Scientific Exploration* (*JSE*). Since then the field of second law challenges has undergone dramatic growth. Over the last ten years, over forty articles on the subject have been published in the general scientific literature, more than during any other decade of the second law's 150 year history [*e.g.*, see References 1-35]. The pace is accelerating. Several independent research groups worldwide are pursuing challenges and the movement from purely theoretical proposals to laboratory experiments has begun in earnest. The first international conference on the subject of second law limits was convened in San Diego in 2002, bringing together more than 120 researchers from twenty-five countries;[13] additional conferences are planned. The first book on the subject commissioned by a major scientific press is due to be published in the next year.[14] Related books are already in print.[15,16] Taken together, these developments signal a fundamental change in how the scientific community views the second law. A paradigm shift may be on the horizon.

Since its publication in *JSE*, the class of second law paradoxes to which this reprinted article speaks has expanded from four to five[17] distinct challenges and a broader understanding has developed, particularly with respect to the gravitational paradox and to the general physical mechanism upon which all are based. Although some details of this reprinted article are now dated, it gives an introduction to most of the challenges investigated at the University of San Diego over the past decade. Author Notes have been added to this text to shore up deficiencies; by no means are they exhaustive.

I would like to thank *JSE* both for its help in originally publishing this work and for its permission to reprint it. I also belatedly thank the *JSE* referees for their critical comments.

Introduction

The second law of thermodynamics is empirical. It has no fully satisfactory theoretical proof. This being the case, its absolute validity depends upon its continued experimental verification in all thermodynamic regimes. Physical processes involving broken symmetries have been the standard touchstones by which its validity has been tested. Recently, four simple paradoxes have been posed which appear to challenge it.[1-12,17] In each, the universe consists of an infinite isothermal heat bath in which is immersed a blackbody cavity. Within each cavity steady-state, non-equilibrium thermodynamic processes create spontaneous asymmetric momentum fluxes which are harnessed to do steady-state work. If one demands the first law of thermodynamics be satisfied by these systems, then apparent contradictions of the second law result. Laboratory experiments and numerical simulations have corroborated theoretical predictions and have failed to resolve the paradoxes in favor of the second law. In this paper, it is shown that a broken symmetry in each of these four systems' thermodynamic properties allows asymmetric momentum fluxes to arise spontaneously, and that these can be harnessed to perform work utilizing a second broken symmetry in each system's geometry. By illuminating this characteristic shared by these paradoxes, it is hoped that their resolution will be expedited.

It may be thought that asymmetries such as these are thermodynamically forbidden and that each system must relax to an equilibrium characterized by spatial homogeneity. This is not the case. In fact, "equilibrium" does not forbid spatial gradients so long as they are *steady-state* ones. For example, the asymmetric momentum fluxes to be introduced shortly in Systems II, III, and IV are no more than steady-state pressure gradients.

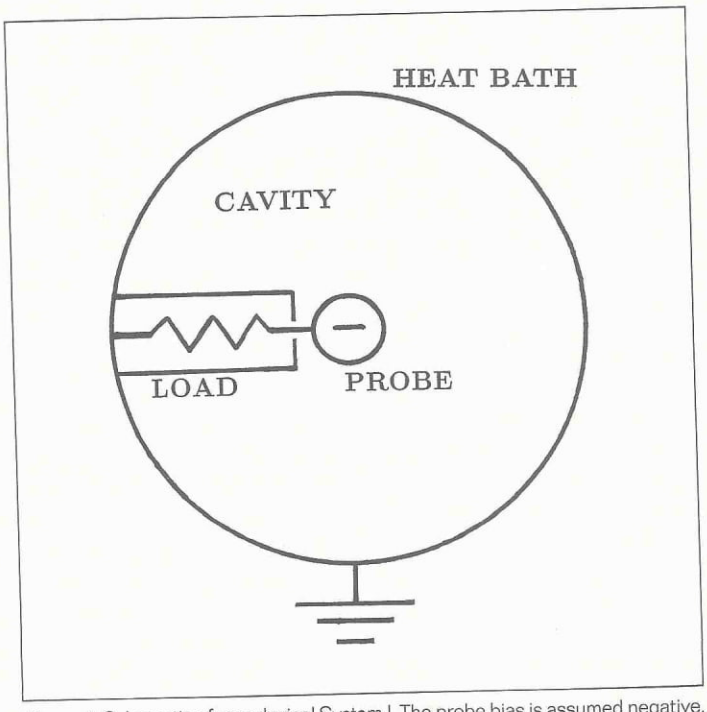

Figure 1. Schematic of paradoxical System I. The probe bias is assumed negative.

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Equilibrium (steady-state) pressure gradients are ubiquitous in nature. For instance, they are standard features of gravitationally-bound, isothermal, static atmospheres on idealized planets. In a uniform gravitational field, one can write the gas pressure as a function of vertical height, z, as $p(z) = p_o exp[-mg(z-z_o)/kT]$, where m is the mass of the gas molecule, kT is the thermal energy, g is the local gravitational acceleration, and p_o is a fiduciary pressure. Clearly, this atmosphere possesses a vertical pressure gradient at equilibrium. Similarly, the pressure gradients in Systems II-IV are steady-state structures, but unlike the atmospheric gradient which is *static* and due to a static potential gradient (gravity), these pressure gradients are *dynamically* maintained by the continuous effluxes from two surfaces having different activities toward the cavity gas. Furthermore, these pressure gradients can do work.

In the next section, the four paradoxes are reviewed briefly and in Section 3 they are discussed in the context of broken symmetries. Detailed descriptions of the paradoxes are found elsewhere.

Four Paradoxes

System I (Plasma I)

System I[2-4] consists of a blackbody cavity containing a low-density plasma and an electrically conducting probe connected to the walls through a load, as shown in Figure 1. The load may be conservative (*e.g.*, a motor) or dissipative (*e.g.*, a resistor). The probe and load are small enough to represent minor perturbations to the cavity properties. The walls are grounded to the heat bath both thermally and electrically ($V_{\text{ground}} = 0$). The potential between the bulk plasma and the cavity walls—the plasma potential, V_p—may be positive or negative depending on the work function and temperature of the walls, and the plasma type and concentration. For an electron-rich plasma and in the absence of any net current to the plasma or walls, V_p may be estimated by equating the Richardson emission, J_R, from the walls to random electron flow from the plasma into the walls:

$$J_R = AT^2 exp\left(-\frac{e\Phi}{kT}\right) exp\left(\frac{eV_p}{kT}\right) = \frac{nev_e}{4} \qquad (1)$$

Here ϕ is the wall's work function, T is temperature, V_p is the plasma potential, v_e is the average electron thermal speed, k is the Boltzmann constant, m_e is the electron mass, n is the plasma particle density, and A is the Richardson constant (about 6 - 12 x 10^5 (A/m^2K^2) for pure metals). Under either equilibrium or non-equilibrium conditions, V_p will be non-zero except for very specific plasma parameters; in particular, $V_p = 0$ at the critical density, $n_c = (4AT^2/ev_e)\ exp[-e\phi\backslash kT]$, as derived from Equation 1.

The probe will achieve a potential with respect to the plasma and walls depending on its temperature, resistance to ground (load resistance, R_L), and the current to it. Since it is nearly in thermal equilibrium with the walls, the probe is self-emissive and, therefore, electrically floats near the plasma potential so long as R_L is large. If $V_p \neq 0$, a current can flow continuously from the probe, through the load, to ground. This current represents an asymmetric momentum flux. The generated power may be expressed as $dW/dt = I_L^2 R_L \approx (V_p^2 / R_L)$. The entropy production rate is $dS/dt = (1/T)\ (dW/dt) \approx (V_p^2 / R_L T)$; this will be positive (negative) for a purely dissipative (conservative) load. Laboratory experiments corroborate this effect.[2] Note: this paradox is not limited to systems with thermionically emitting walls and probe; any plasma with a non-zero floating potential appears viable.[3]

If this system does steady-state work on the load while maintaining spatially steady-state temperature and species concentration profiles, and if the first law of thermodynamics is satisfied, then a paradox involving the second law naturally develops. Formally, the first law states: $[\Delta Q - \Delta W]_{hb} = -[\Delta Q - \Delta W]_c$, where *hb* refers to the heat bath and *c* refers to the cavity. The heat bath supplies heat, but does no work, so $\Delta W_{hb} = 0$. If the load is conservative and each part of the cavity is at a steady-state temperature, then $\Delta Q_c = 0$. (It is assumed, without further justification, that there are no net phase changes or chemical reactions in the cavity.) Returning to the first law, since $\Delta W_{hb} = 0$ and $\Delta Q_c = 0$, this leaves $\Delta Q_{hb} = \Delta W_c$. The cavity does positive work, so $\Delta W_c = \Delta Q_{hb} < 0$; in other words, the work performed by the load is drawn as heat from the heat bath, a reasonable result.

Now consider the second law. Entropy is an additive thermodynamic quantity so the entropy change for the universe can be written: $\Delta S_{universe} = \Delta S_{hb} + \Delta S_c$. Since $\Delta Q_c = 0$, one has for the cavity, $\Delta S_c = \Delta Q_c / T = 0$. (Equivalently, one may argue that entropy is a state function and the closed cavity is in a steady state—having no net phase changes, chemical reactions, temperature or volume changes, the number of microstates available to it is fixed—thus the entropy of the cavity is time invariant, and so $\Delta S_c = 0$). With $\Delta S_c = 0$, one is left with: $\Delta S_{universe} = \Delta S_{hb} = \Delta Q_{hb} / T_{hb} < 0$. This violates the second law of thermodynamics, namely that for any spontaneous thermodynamic process, $\Delta S_{universe} \geq 0$. If one replaces R_L with a dissipative load, the second law is violated still, since a forbidden, permanent temperature gradient has been established between the load and the cavity ($T_{load} > T_c$). Note that this system is not in thermal equilibrium; this process is irreversible. In order to use validly equilibrium thermodynamic relations, the work must be performed "slowly." This can be achieved to any degree of precision desired by adjusting the load resistance. Similar arguments establish the remaining three paradoxes. Note also, neither this system nor the other three utilize standard thermodynamic cycles or a low temperature heat reservoir.

System II (Plasma II)

Paradoxical System II[5] is a mechanical analog to System I. Too, it consists of a blackbody cavity surrounded by the heat bath. The cavity contains a low-density ionizable gas, *B*, and a frictionless, two-sided piston (see Figure 2). As before, Richardson emission greatly exceeds ion emission for all surfaces, giving an electron-rich plasma with a negative plasma potential. The majority of the piston is of identical composition as the walls (surface type 2, *S2*), however, on one piston face is a small patch having a different work function (surface type 1, *S1*). It is small in the sense that it is relatively unperturbing to global plasma properties. The work functions of *S1* and *S2* and the ionization potential of *B* are ordered as: $\phi_1 \gtrsim I.\ P. > \phi_2$. Plasma production is straightforward: electrons are "boiled" out of the metal (Richardson

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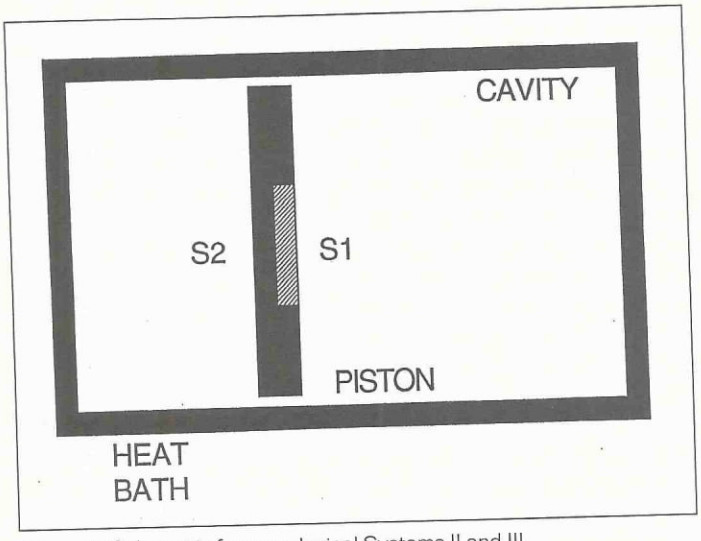

Figure 2. Schematic for paradoxical Systems II and III.

emission) and ions, created by surface ionization, are accelerated off the metal surface by the electron negative space charge. Ions, in turn, ease the electrons' space charge impediment, thus releasing a quasi-neutral plasma from the surface. Actually, if $V_p < 0$, this is essentially a charge-neutralized, low-energy ion beam leaving the surface. In fact, this plasma can be roughly considered to be an unmagnetized, three-dimensional Q-plasma with a sliding hot plate.[36,37]

The ordering $\phi_1 \gtrsim I.\ P. > \phi_2$ allows, with appropriate plasma density and temperature, and surface areas ($(SA)_2 >> (SA)_1$), the following: surface 1 ionizes B well and recombines it poorly while surface 2 ionizes B poorly, but recombines B well. Surface 2 dominates plasma properties by virtue of its greater surface area ($(SA)_2 >> (SA)_1$), therefore, the net flux of B to any surface is predominantly neutral B. Surface 1 will be relatively unperturbing to cavity plasma conditions if the $S2$ ion current into the plasma is much less than the total $S1$ ion current. The electron emission off $S2$ exceeds that off $S1$ by a factor $exp[(\phi_2 - \phi_1)/kT]$. The electron current density from each surface is given by Equation 1.

Because of the differences between neutral, electronic, and ionic masses and the different currents of each leaving $S1$ and $S2$, a steady-state asymmetric momentum flux density (a "net pressure difference," ΔP), is sustained between piston faces. It has been shown that this pressure difference is roughly

$$\Delta P \approx -\frac{p_{i,2} n_n kT}{2} - \frac{\pi}{4}\frac{m_e v_e}{e} J_{R,1} + m_i \frac{n_n v_n}{4} p_{i,2}\sqrt{-\frac{2eV_p}{m_i}} \qquad (2)$$

where $p_{i,2}$ is the ionization probability of B on $S2$, n_n is the neutral density, $J_{R,1}$ is the Richardson current density from $S1$, m_i is the ion mass, and v_n is the neutral thermal velocity. The first, second, and third terms represent neutral, electronic, and ionic pressures, respectively. Laboratory experiments corroborate steady-state differential thermionic emission from different surfaces under blackbody conditions.[5] Numerical simulations, using realistic physical parameters, indicate the pressure effect is small, but significant.[2] If the piston moves slowly ($v_{piston} << v_n$) and performs work quasi-statically, it generates steady-state power, $(dW/dt)_{piston} = \Delta P\ (SA)_1\ v_{piston}$, and produces negative entropy at the rate, $dS/dt = (1/T)(dW/dt)_{piston}$. Notice that, even in the absence of a plasma potential, V_p, the paradoxical effect persists so long as the ionization probability of the two surfaces are distinct.

System III (Chemical)

Paradoxical System III[6-8] is the chemical-mechanical analog of System II. It consists of a blackbody cavity with piston into which is introduced a small quantity of dimeric gas, A_2. The cavity walls and piston are made from a single material, surface type 2 ($S2$), except for a small patch of a different material, surface type 1 ($S1$), on one piston face, as shown in Figure 2. (Note $S1$ and $S2$ here are distinct from those in System II.) The chemical model for this system assumes the following: a) the gas phase density is low such that gas phase collisions are rare compared with gas-surface collisions, however, it is sufficiently high that rms pressure fluctuations are small compared with the average pressure; b) all species contacting a surface stick and later leave in thermal equilibrium with the surface; c) the only relevant surface processes are adsorption, desorption, dissociation, and recombination; d) the fractional surface coverage is low, so adsorption and desorption are first order processes; e) A_2 and A are highly mobile on all surfaces and may be treated as a two-dimensional gas; and f) atomic and molecular species are retained sufficiently long on any surface to achieve close to chemical thermal equilibrium in the surface phase. These conditions are physically realistic and have been shown to be self-consistent.[6] For these conditions, it can be shown that, in principle, $S1$ and $S2$ can simultaneously desorb different ratios of A and A_2 in a steady-state fashion. However, since two A's together impart $\sqrt{2}$ times the impulse to the piston as does a single A_2 (all leaving in thermal equilibrium with the surface), asymmetric momentum fluxes can be sustained between the piston surfaces. (Another way to view this is: equipartition of energy does not imply equipartition of linear momentum.) The pressure imbalance on the piston faces can be used to perform work in a similar manner to System II.

For low surface coverage where desorption is a first order process, the desorption rate ratio for A and A_2, $R_{des}(A_2) / R_{des}(A) \equiv \alpha$, is given by:

$$\alpha \equiv \frac{R_{des}(A_2)}{R_{des}(A)} = \frac{n(A_2)}{n(A)}\frac{F(A)}{F(A_2)}\exp\{\frac{\Delta E_{des}(A) - \Delta E_{des}(A_2)}{kT}\} \qquad (3)$$

Here $\Delta E_{des}(A_j)$ is the desorption energy of A_j; $n(A_j)$ is the surface concentration of A_j (m^{-2}); and $F(A_j) \equiv (f / f^*)_{Aj}$ is a ratio of partition functions. f is the partition function for the species in equilibrium with the surface, and f^* is the species-surface partition function in its activated states. For real surface reactions, $F(A_j)$ typically ranges between roughly 10^{-3} - 10^4. Experimental values of desorption energy, ΔE_{des}, typically range from about 1 kJ/mol for weak physisorption up to about 400 kJ/mole for strong chemisorption.

The ratio α varies as $0 \leq \alpha \leq \infty$ depending on the values of the several variables in Equation 3. Experimental signatures of differential α's (some under quasi-blackbody conditions) are abundant.[38-41] If $\alpha_1 \neq \alpha_2$, and if the instantaneous fluxes of A and A_2 from $S2$ each greatly exceed those from $S1$ so that $S1$ can be treated as an impurity, *i.e.* $R_{des}(2,A_2)/R_{des}(1,A_2) >> (SA)_1/(SA)_2$ and $R_{des}(2,A)/R_{des}(1,A) >> (SA)_1/(SA)_2$, then a steady-state difference

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in momentum flux density (net pressure difference, ΔP) can be sustained between piston faces. Here $(SA)_j$ is the surface area of the jth surface. This pressure difference can be expressed:

$$\Delta P = \left(2-\sqrt{2}\right) m_A v_A R_T(A) \left[\frac{\alpha_2 - \alpha_1}{(2\alpha_1+1)(2\alpha_2+1)}\right] \quad (4)$$

where $R_T(A)$ is the total flux density of A onto a surface, $R_T = [n(c,A)v_A + 2n(c,A_2)v_{A2}]/\sqrt{6\pi}$. Here $n(c,A_j)$ is the cavity concentration of A or A_2. In the limit that $\alpha_2 >> 1 >> \alpha_1$, the greatest pressure difference is obtained; it is roughly: $\Delta P \approx 0.3\ m_A v_A R_T(A)$. This pressure difference is steady-state since the dynamic chemical processes giving rise to it are steady-state. If this pressure difference is significantly greater than the statistical pressure fluctuations in the cavity, then, in principle, it can be exploited to do steady-state work. The power and entropy production rates here are the same as for System II. As for System II, the piston must move *slowly* compared with the thermal velocity of gaseous A_2. Note that, when the piston moves, the volume and surface phases for this system are not in equilibrium; in fact, they are in steady-state non-equilibrium.

This chemical system has been simulated numerically.[6] Closed-form, analytic rate equations have been developed and solved simultaneously using realistic physical parameters. Solutions confirm the possibility of this paradoxical effect; it is probably small—but significant—and appears viable over a wide range of physically accessible parameters. Laboratory systems displaying this effect are currently being sought. [Author Note: Laboratory experiments have been conducted that strongly corroborate the essential gas-surface reactions of this model.[8] Differential dissociation rates of molecular hydrogen were observed on high temperature tungsten and molybdenum surfaces under identical thermodynamic conditions (temperature, gas pressure).]

System IV (Gravitational)

[Author Note: The theory for this paradox has been superceded in several subsequent publications; the reader is directed to them.[9-12] Corroborative laboratory experiments for fundamental physical processes were carried out.[9]]

To introduce System IV, consider an everyday scenario: from the same height, drop a glass marble onto two different surfaces, for instance, a hard wood floor and a soft rug. The marble inelastically rebounds to different heights, demonstrating the different inelastic (endoergic) responses of the two surfaces. Inherently, these collisions are non-equilibrium processes. Analogous non-equilibrium behavior is observed on the atomic scale: it is well known that hyperthermal gas-surface collisions can excite energy states associated with internal degrees of freedom of either the collider or target—*e.g.* rotational, vibrational and electronic modes, phonons, plasmons—thereby rendering the collisions inelastic.[42-46] In fact, a number of standard surface diagnostics are based upon just such characteristic inelastic responses.[42-46] In contrast, at thermal equilibrium gas-surface collisions must, on average, be *elastic*, otherwise more direct contradictions with the second law arise. ("Hyperthermal" collisions are those with impact energies far above thermal energies—typically a few tenths of an e*V* up to about 100 eV in energy.) Studies indicate energy transfer efficiencies from hyperthermal colliders to targets can range from a few percent to over 90% of incident atom kinetic energies.[42] Motivated by these observations, a simple, idealized system is considered: a strongly gravitating rod, whose ends have different inelastic responses to hyperthermal impacts by a particular gas, is placed at rest in a blackbody cavity with that gas. When steady-state is reached, gas continuously falls hyperthermally onto the rod, inelastically rebounds to different degrees from the rod ends, and is rethermalized in the blackbody cavity. The particle fluxes to and from both rod ends are identical, but the momentum fluxes are different, giving rise to a net force on the rod. If released, the rod accelerates in the direction of the net force and, in principle, can be harnessed to do mechanical work.

The idealized system consists of: (i) an infinite heat bath; (ii) a large, spherical blackbody cavity; (iii) a low density gas in the cavity; and (iv) a rod gravitator. The rod (length $2L_g$) has symmetric mass density $\rho(x) = \rho(-x)$ about its center at $x = 0$, but its end surfaces ($S1$ and $S2$) are composed of two materials distinct in their inelastic responses to gas atoms (mass m_A). In other words, for $S1$ and $S2$ one can write the inelastic response functions as distinct: $v_f(1,v_i) \neq v_f(2,v_i)$. The inelastic response function for surface j, $v_f(j,v_i)$, maps the velocity of a particle before impact, v_i, onto its velocity after impact, v_f.

The rod represents a minor perturbation to the overall cavity properties. Its gravitational scattering length L_s is much smaller than the cavity scale length, L_c. As a result, N_s, the ratio of the average number of wall collisions a gas atom undergoes (N_{wall}) to the number of rod collisions (N_{rod}) it undergoes, is large; that is, $N_s \equiv N_{wall}/N_{rod} \approx (L_c/L_s)^2 >> 1$. Gas colliding with the cavity walls, regardless of its history, is diffusely scattered (for rough walls), well mixed, and fully thermalized within a few wall collisions. For the rod at rest at the cavity center then, gas populations infalling from the walls to $S1$ and $S2$ may be taken to be fully thermal and identical in temperature and density. In terms of the velocity distribution functions, this is: $f_I(1,|v|) = f_I(2,|v|)$ and $f_{II}(1,|v|) = f_{II}(2,|v|)$. The velocity distributions for gas infalling from $x = \pm L_c$ are half-Maxwellians, $f_I(j,v)$. When they arrive at $S1$ and $S2$ they are velocity space compressed due to their falls through the gravitational potential, becoming $f_{II}(j,v)$. The rebounding distributions, $f_{III}(j,v)$, are distinct for the two surfaces. After climbing out of the gravitational well, the velocity space expanded distributions $f_{IV}(j,v)$ are rethermalized at the walls. Gravitationally bound gas, $f_V(j,v)$, forms an atmosphere around the rod. The cavity contains blackbody radiation and gas whose mean free path is comparable to or greater than the distance between the rod and the walls. Gas kinetic energy fluxes are much smaller than radiative energy fluxes; in other words, blackbody radiation dominates the system's energy transfers. Small surface temperature variations arising from inelastic collisions are quickly smoothed out by compensating radiative in- or effluxes. This model is valid over a wide range of physically realistic parameters and is well approximated by a planet-sized gravitator in a low density gas housed in blackbody cavity of solar system dimensions. In the following analysis, the rod will be treated one dimensionally; however, it can be shown, in retrospect, that the following results generalize to two and three dimensions.

The net force on the stationary rod can be determined

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from conservation of linear momentum, accounting for both incident and reflected particle fluxes. As discussed previously, since $f_I(1,|v|) = f_I(2,|v|)$ and $f_{II}(1,|v|) = f_{II}(2,|v|)$, by symmetry, the net force on the rod (at rest) due to incident gas is zero. However, the net force due to the inelastically reflecting gas need not be zero since $f_{III}(1,|v|) \neq f_{III}(2,|v|)$ and $f_{IV}(1,|v|) \neq f_{IV}(2,|v|)$. Consider the *S1* rod end. The incident particle flux density which infalls from the walls at $x = -L_c$ to *S1* at $x = -L_g$ is $N_i(1) = \int_0^{\infty} v f_{II}(1,v)dv$. From conservation of mass, the incident particle flux density is equal to the reflected particle flux density: $N_i(1) = N_f(1) \int_0^{-\infty} v f_{III}(1,v)\, dv$. The differential momentum flux density for the rebounding gas (taken at $x = -L_g$) is $dF_p(1) = [m_A v]\, dN_f(1) = m_A v^2 f_{III}(1,v)dv$. Only atoms with $v \leq -v_{esc}$ will climb completely out of the gravitational potential well; the remainder will fall back to the rod, form an atmosphere, and eventually evaporate as the ($v \leq -v_{esc}$)-tail of $f_V(1,v)$. Accounting for the gravitational back-reaction of the gas on the rod as it climbs out of the gravitational well, the total average steady-state momentum flux density on surface *S1* is:

$$F_P(1) \approx M_A \int_{-v_{esc}}^{-\infty} v\sqrt{v^2 - v_{esc}^2}\,[f_{III}(1,v) + f_V(1,v)]\, dv \qquad (5)$$

The approximation (≈) is due to the finite cavity size; in the limit of $-L_c \to -\infty$, the expression becomes exact. For *S2*, $-v_{esc} \to +v_{esc}$ and $-\infty \to +\infty$ in the limits of integration. In the limit of a tenuous atmosphere, the momentum flux density due to the ($|v| \geq |v_{esc}|$)-tail of $f_V(j,v)$ is negligible; in fact, $f_V(j,v)$ is negligible for systems with low gas densities, n_A, and with inelastic response functions, $v_f(j,v_i)$ which do not shift $|v_f|$ significantly below $|v_{esc}|$.

By conservation of linear momentum, the average net momentum flux density (pressure) on the rod as a whole is $\Delta F = F_p(1) - F_p(2)$. If $v_f(1,v_i) \neq v_f(2,v_i)$ in the velocity range of the colliding gas, then except under extremely contrived conditions, one has $\Delta F \neq 0$. In other words, under steady-state thermodynamic conditions, a stationary, gravitating rod with different inelastic responses on its ends can, in principle, experience a non-zero, steady-state force when placed in a suitable gas. If the rod is released, this force can be harnessed to do work at the expense of the heat bath, as discussed previously.

System V. (Solid State) [Author Addition]

The solid state paradox was investigated after the original *JSE* article; details can be found elsewhere.[17] Briefly, it involves the tapping of thermally-generated electrostatic potential energy of p-n junction diodes. It is the first room-temperature, commercially viable second law challenge to appear in the general scientific literature. Laboratory experiments are planned.

Two Broken Symmetries

Each paradox arises due to a synergism between two broken symmetries—one thermodynamic and one geometric. Each is necessary, but alone insufficient. A broken geometric symmetry is constructed into each system. System I possesses almost perfect radial symmetry; this symmetry is broken by the electrical connection from the probe, through the load, to ground. In the case of disconnection, the probe will randomly and radially receive current from the walls through the plasma and radially and randomly return this current to the walls back through the plasma. This is the equilibrium (fully symmetric) case. If the load is connected, however, the probe's return current has an alternate path to ground and the radial symmetry of the current flow is broken. Analogously, in Systems II-IV, the piston's constrained, one-dimensional motion effectively reduces (breaks) the systems' three dimensionality to one.

These broken geometric symmetries are necessary to exploit each system's broken thermodynamic symmetry. The latter may be identified by observing which thermodynamic property, if symmetrized, destroys the paradoxical effect. In System I, the effect is lost if the plasma potential is *symmetrized* to $V_p = 0$. (It is assumed here that for self-emissive probes the floating potential for a probe is equal to the plasma potential.) This can be made zero in several ways including i) ceasing plasma production; ii) achieving the critical plasma density, n_c; or iii) creating a mass-symmetric plasma—a negative ion plasma. More generally, the non-zero V_p can be considered due to either a) the fundamental mass asymmetry between electron and ions; or b) that surfaces preferentially emit electrons or ions depending on values of their surface temperature and work function, and gas ionization potential.

In System II, the paradoxical effect is lost if the work functions of *S1* and *S2* are equal: $\phi_1 = \phi_2$. Then, the electronic, ionic, and neutral momentum flux densities from all surfaces are identical, rendering zero the pressure differential between piston faces. In general, the symmetry condition, $\phi_1 = \phi_2$, is difficult to achieve unless *S1* and *S2* are the same material—a trivial case.

In System III, the effect is lost if the desorption rate ratios for *S1* and *S2* are equal: $\alpha_1 = \alpha_2$. As seen from Equation 3, this requires either fine tuning in values of surface density, partition functions, and desorption energies, or that *S1* and *S2* be identical substances. As with ϕ in System II, the symmetry condition, $\alpha_1 = \alpha_2$, is difficult to achieve unless *S1* and *S2* are identical. In System IV, the effect is lost if $v_f(1,v_i) = v_f(2,v_i)$. This is most easily accomplished by symmetrizing the rod's composition.

Each broken thermodynamic symmetry (in V_p, ϕ, α, or $v_f(j,v_i)$) occurs naturally under either equilibrium or non-equilibrium conditions and allows momentum flux asymmetries to arise. Via the broken geometry symmetry, the broken thermodynamic symmetry is exploited to do work. Both broken symmetries appear to be necessary since the thermodynamic quantities V_p, ϕ, α, $v_f(j,v_i)$ are spatially homogeneous (independent of spatial variables); therefore, by themselves they are insufficient to direct momentum fluxes to do work. This requires the broken spatial (geometric) symmetry; in System I it is accomplished by an electrical conductor and in Systems II-IV by a piston. From these four examples,[1] a conjecture is induced: Given a spatially homogeneous thermodynamic property that causes an asymmetric momentum flux (under equilibrium or non-equilibrium conditions), a second broken geometric symmetry is necessary and, if suitably arranged, can be sufficient to do work solely at the expense of a heat bath in violation of the second law.

(It is noted that System IV was not used in inducing this conjecture; on the contrary, it was deduced from it. As a personal challenge, the author cooked it up to test whether the conjecture induced from Systems I-III could hold for gravi-

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tational systems as it seemed to apply for electromagnetic ones. Apparently, it can.)

[Author Note: Unknown to the author at the time of the original *JSE* article, several years prior (1992) a proof was given by Zhang and Zhang,[47] demonstrating formally much of the essence of this last section. Specifically, they showed that what they called "spontaneous momentum flows" (SMF) are necessary and sufficient conditions for second law violations. These paradoxes can be shown to satisfy the Zhang criteria for second law violation. In the last year it has also been realized that the entire class of paradoxes share the common feature of macroscopic potential gradients (*e.g.*, chemical, electrostatic, gravitational) by which particle fluxes are used to extract energy ultimately from a heat bath (Ref. 13, p. 195).]

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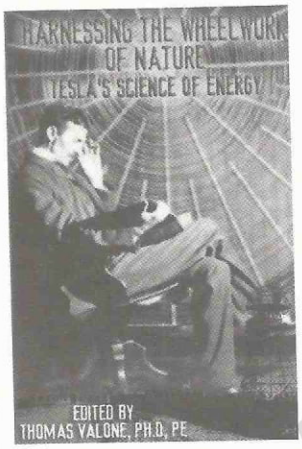

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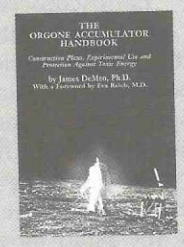

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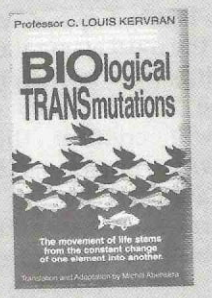

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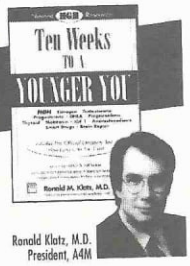

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Bring Me the Head of Maxwell's Demon!

Using Computer Simulation and Nanotechnology to Demonstrate Second Law Violation

Kevin Varner*

"Every generation laughs at the styles of the previous generation." — *Henry David Thoreau*

This article puts a finer point on themes that were explained in my previous *Infinite Energy* article.[1] Loyal readers will remember that the first article discussed a process I called "tethered-solute osmosis" and its capacity for demonstrating violation of the Second Law of Thermodynamics. Molecular ratchets were also mentioned.

To better understand what the big Second Law joke is about, I will give the reader some background information. The need for these preliminary paragraphs is validated by the following fundamental truth: the average person doesn't know Maxwell's Demon from Whistler's Mother.

The Second Law of Thermodynamics asserts that always and forever, as long as eternity rolls, there will never be a way to harness as an energy source random motion *at the molecular level*—without a lower temperature reservoir into which to dump waste energy. In due time, I will prove that random motion on a visible (macroscopic) level can be harnessed easily. It will then be proposed that what is true macroscopically will remain true nanoscopically. Nevertheless, modern science resolutely maintains that if *molecules* are doing the random motion thing, such motion *cannot be harnessed*. We can start to grasp the implication of any clear threat to the Second Law when we come to understand that gas pressure is explained by the rapid movements of randomly directed molecules. Figure 1 symbolizes this. Even the most elementary texts dealing with something called "the kinetic theory of matter" will confirm this. Information on the related topic of Brownian motion can be found in a popular-level treatment by Lavenda.[2]

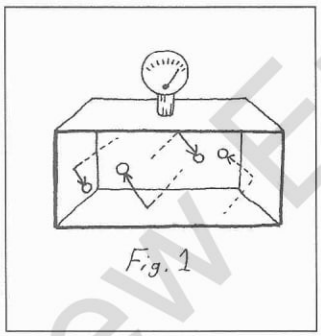

Fig. 1

A quote from a 1916 book by Jean Perrin[3] supplies specific numbers with respect to the magnitude of randomized thermal energy in matter:

> The work done by the stoppage, at this temperature [0°C] of all the molecules contained in 32 grams of oxygen or 2 grams of hydrogen would be sufficient to raise 350 kilograms through one meter; this shows what a reserve of energy lies in molecular motion. . . Again, at the temperature of melting ice, the kinetic energy for [32 grams of] oxygen is the same as if, supposing that all the molecules were stopped, the mass considered had as a whole the velocity of 460 meters per second. . .This is not much less than the speed of a rifle bullet.

A *Scientific American* article by Ehrenberg that appeared in November 1967[4] puts the spotlight on what it would mean to civilization if such energy could be harnessed:

> A practical system with immunity from the Second Law of Thermodynamics would be the ultimate prime mover, capable of returning the fuel after the work is done. Undoubtedly, such a system would have economic consequences far greater than, say, nuclear power, and a few decades ago a nuclear power station would have been considered a project equally fantastic.

The title of Ehrenberg's article is "Maxwell's Demon." It is alleged by the keepers of the truth of modern science that this Demon *must process information* in order to operate a trapdoor system for harnessing gas pressure. This is supposed to negate its usefulness. What follows is a description of this character, as reprinted from my prior article in *Infinite Energy:*

> In reference to Figure 2 (yeah right, the guy holding his tail is the Demon), the randomly-flying gas molecule *cannot* accumulate on one side of the partitioned box by knocking past the trapdoor hole all by themselves. According to modern physics, some type of energy input (symbolized by the flashlight held by the Demon) is needed to *inform* the Demon when a specific molecule has the right trajectory to pass through the door. It is supposed to be the case that the energy needed to produce the information required by the Demon so he can open the trapdoor at just the right moment is greater than the energy acquired (pressure increase) provided by the trapped molecule. You got all that?

The dogma in the previous paragraph is fully reasserted in a second *Scientific American* article by IBM computer scientist Charles Bennett.[5] This popular-level discussion appeared

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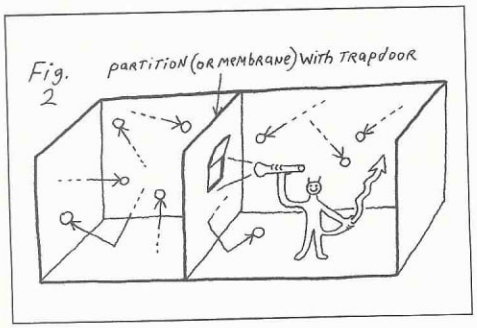
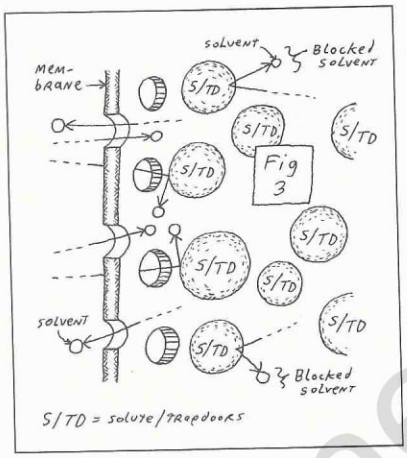


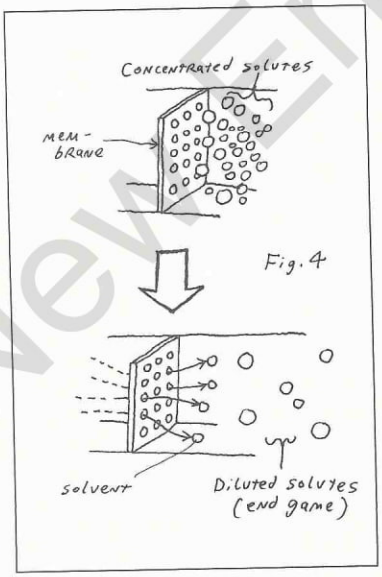
exactly twenty years after the Ehrenberg piece. According to Bennett, there are minimum energy requirements with respect to performing computations. That would be all fine and good and harmless if such a woolly assertion never escaped the laboratory or college lecture hall. However, Bennett goes on to state (in full seriousness) that as a result of this alleged energy/computation linkage, molecular level trapdoors will jiggle too much to function. He is not alone: Others have said as much under the banner of something called "information theory." A 1990 list of relevant citations can be found in Leff and Rex.[6]

I will now expose the amazing folly of this false connection. When I'm finished, we will see that a *"headless" Maxwell Demon* will function perfectly well. Intelligent trapdoors are superfluous.

To understand my reasoning, it is necessary to comprehend: 1) the nature of osmosis, and 2) the fact that osmosis can be *computer simulated*.

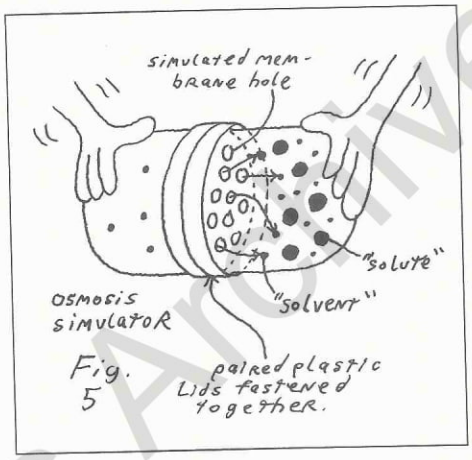
Osmosis is fundamentally a very simple process. This belies the super-mathematical content of books that supposedly "explain" it.[7] As shown in Figure 3, osmosis is essentially a trapdoor interaction in which freely-mobile solutes in proximity to a porous membrane tend to block solvent particles coming from the solute side (note "blocked solvent" labels on Figure 3). On the other hand, the randomly-moving solvent particles cruising through the membrane from the non-solvent side are able to shove past and push aside the bulky solutes. The outcome of such activity repeated countless trillions of times is illustrated in Figure 4. The solutes that were initially concentrated near the membrane have a tendency to self-dilute and disperse. The "endgame" is a tapering off and cessation of fluid transfer.





A source of validation for this elementary treatment of nanoscale osmosis is the macroscopic simulator noted in a peer-reviewed journal in 1999.[8] An equivalent version of this simulator can be constructed out of a couple of snap-lid plastic containers, as I pointed out in my prior *Infinite Energy* article. Figure 5 shows the apparatus; note that it must be actively shaken to simulate molecular motion.

The literature teaches that it is perfectly acceptable to use so-called "chaotic motion generators" to simulate the behavior of particles millions of times smaller than randomly moving macroscopic test particles. You can look it up; the excellent 1938 book by Sutton[9] gives ideas for the macrolevel physical simulation of gas pressure. Also relevant is work on duplicating the instantaneous velocity distributions of molecules.[10] Atomic particle motions are governed by Newton's laws, just like test particles millions of times larger. Yes, there are electrical attraction/repulsion forces too, which are more significant at the nanolevel, but this does not negate my statement.

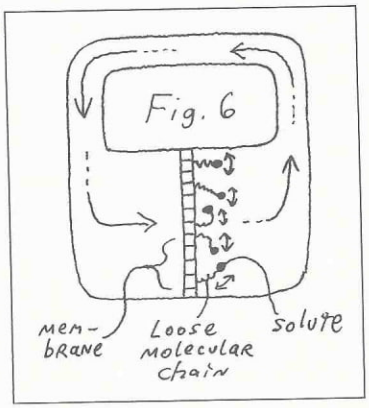


I now come to a source of validation for osmosis models that breaks new ground with respect to my first paper. I refer to *computer-based* simulation of osmosis. I am confident that future generations will be amused by the following irony: Computerized simulation will be one of the key factors demonstrating the falsity of the Second Law. Machines made by Charles Bennett's employer (IBM) will be used to show that "information theory" does not constrain molecular level trapdoors.

Before getting too far ahead of myself, let me note a fistful of papers extracted from the journal literature that report on successful numerical osmosis models.[11-15]

As a near-term project, I propose that such models be upgraded to simulate monolayers of solutes *tethered to one side* of a membrane using loose molecular chains. Numerical models of flexible polymer chains have been available for several years.[16-20] I predict that after such software is assembled and loaded, when the start button is engaged, the outcome will finally retire an old legend that appeared in *Foundation of Physics* in 1981:[21] "No microengines which could utilize the gradients of the thermodynamic parameters between microdomains [*i.e.*, random molecular motion] have yet been constructed, found in nature, or represented in theory."

As represented in Figure 6, my expectation is for the model to show what amounts to *perpetual osmo-*



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sis. Such a process violates the Second Law.

Given a truthful software model, success seems inevitable since the membrane is not smart enough to know the difference between tethered and untethered solutes. This presents a paradox to Second Law-believing information theory advocates: They must supply some mechanism for giving warning signals to the membrane to eternally ignore *only the tethered solute molecules* and respond (in terms of osmotic fluid transfer) only to freely-mobile untethered solutes. As I stated in my prior paper, "Allowing anti-Second Law perpetual motion would be much easier!"

As the title of this article says, you can "bring me the head of Maxwell's Demon," but that really will not make any difference. Intelligent trapdoors are hereby out of fashion; stupid trapdoors are the latest style. At least the title of this article served the purpose of getting your attention.

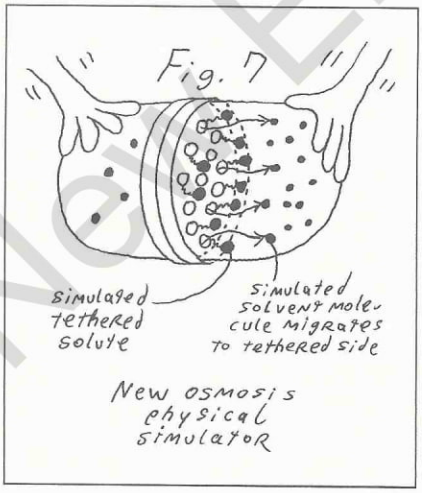
It is certainly possible to modify the Figure 5 physical model to demonstrate this new form of osmosis. The resulting contraption will look like the Figure 7 illustration. Readers of this article might like to know that I actually invested a few hours of spare time and built a model for editor Eugene Mallove and his crew in New Hampshire.

As symbolized in the cartoon in Figure 8, the old saying "garbage in, garbage out" can be a hidden nemesis of computer simulation. Haile, author of the 1992 book *Molecular Dynamics Simulation*,[22] gives firm and insistent recommendations as to how to avoid errors and false conclusions.

A clearly false conclusion by a computer model of a trapdoor membrane was slammed in my first article. This model was proposed by Skordos and Zurek.[23] I considered it biased since their model insisted that anti-Second Law membrane-connected trapdoors must be *actively cooled* in order to function.

Constructing tethered solute osmosis simulations on the foundation of simulation software for ordinary osmosis seems like a good way to avoid such bias. My review of papers concerning simulation of ordinary osmosis[11-15] indicates that none of the models specify that untethered solutes be actively cooled. Very clearly, if they did, they would deserve wholehearted *rejection*!

Ordinary osmosis occurs with the solutes and solution molecules at the same temperature. Simulation of tethered-solute osmosis must be founded on the same "isothermal premise." It only makes sense after all: When you sit down and think about it, *why all of a sudden* should a solute molecule need to be cooled in order to promote osmotic fluid transfer simply because a loose chain (polymer) connects it as part of a monolayer on one side of a membrane? Any presumptuous constraint with respect to trapdoor cooling seems highly artificial.



The computer models of ordinary osmosis are detailed enough to simulate the harmonically vibrating molecules constituting the solid membrane itself. In fact, one of the first simulations, reported by Murad and Powles in 1993,[11] said specifically: ". . .the atoms that constitute the membrane are tethered to their equilibrium positions by a simple harmonic interaction potential."

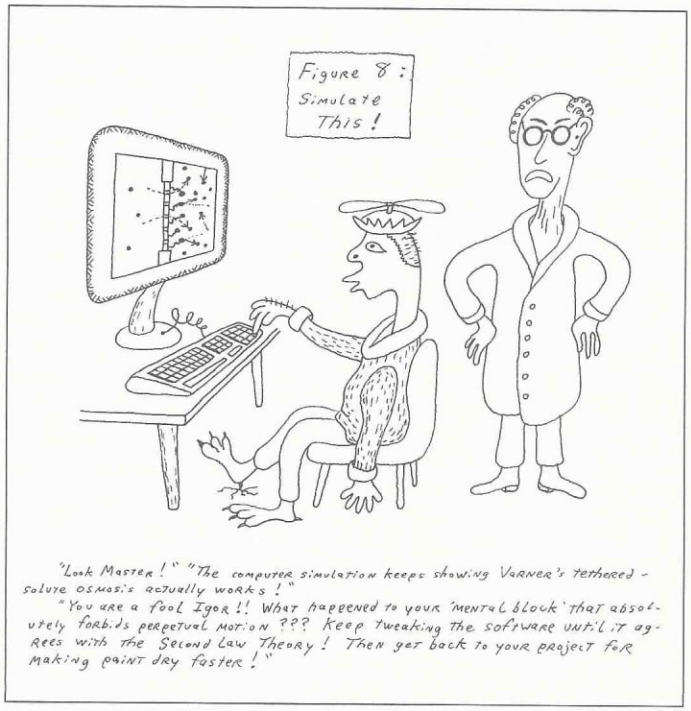
When you have such a situation, it should be easy to understand that a certain amount of random scattering (as opposed to mirror-like scattering) of atoms and molecules (solutes/solvents) will occur. Anyone with a working eye can see that a vibrating mirror will produce a fuzzy reflection. Nevertheless, the same Newtonian mechanics that governs the behavior of macrolevel physical simulators of gas pressure, the Maxwell-Boltzmann velocity distribution curve, and ordinary osmosis[8-10] remain 100% operational at the nanolevel.

I choose to emphasize the above point owing to Ken Rauen's "red herring" comments on molecular scattering that followed my first article.

A primary reason for going public with my observations is to "shake the tree" in terms of identifying any sort of anti-Second Law prior art. Aside from acknowledging Ken Rauen's comments at the end of my first article, there has been (at the time of this writing) very little critical feedback or argument against any of my observations.

Given enough time, possibly someone, somewhere will uncover an anti-Second Law effect that was casually noted in the scientific literature but was not at first recognized for what it really represented. The point I am making finds expression in another context. I supply here a quote from Franklin's *Experiment, Right or Wrong*,[24] dealing with an issue in the physics of subatomic particles:

> During the 1960s events now attributed to weak neutral currents were seen but were attributed to neutron background. At the time there was no theoretical prediction of such currents. Later, after theory had predicted the existence of these currents, new



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experiments reported their existence and the earlier experiments were reinterpreted.

A singular example of a report of "nonclassical behavior" having potentially grave implications for the Second Law appeared on page 201 of a 1958 book by R.U. Bonner *et al.*[25] ". . .some specimens of membrane appear to exert an osmotic pressure when pure solvent is on both sides of the membrane; this pressure is termed 'asymmetry pressure.'"

After reading this, I immediately began a literature check using the terms "asymmetry (pressure)." The trail eventually proved to be a cold dead end. I located nothing dealing with membranes with respect to the above search terms.

For some background on what might someday be seen as nonclassical behavior on the part of enzymes, see References 99-103.

The way to move forward, it seems to me, is to keep pressing with respect to such things as computer modeling of tethered solute osmosis as a method for perpetual fluid transport.

It is presently unknown to me how difficult it is to carry out computer simulation of the type suggested above. Perhaps it may only require state-of-the-art, yet reasonably accessible, desktop equipment. In such a case, perhaps one or more readers of *Infinite Energy* could step forward and provide support. The results could be swiftly posted on the Internet. This would have the effect of bypassing the peer-review process that can destroy forbidden novelty. Somewhat slower would be publication in *Infinite Energy*.

On the other hand, a realistic simulation might require more extensive facilities. I do know about the existence of the Minnesota Supercomputer Institute at the University of Minnesota. I even tried to call them in March 2002, but my calls were not returned. In general, when I have tried to contact academic facilities for help concerning strange ideas, the doors tend to stay firmly closed. I assume the same mute behavior will be repeated if I decided to contact one of the Chicago-based authors of the above-noted computer-simulated osmosis papers.[11-15]

For the sake of completeness, I note that the Chicago group seems to have simulated a "negative osmosis" diffusion process related to the "isomer ratchet membrane" (see Figure 9). It is important to give credit where credit is due. I base this on the following quote from a 1997 paper by Powles *et al.*:[26] ". . .an osmosis engine which would perform external work. . .driven by the strong attraction of the solute molecules."

Both my scheme (embodied in Figure 9) and the negative osmosis prediction of the Chicago group seem closely related to the modus operandi of the "fountain effect" associated with a liquid helium superfluidity phase transition. This effect was first reported in 1938 by Allen and Jones.[27] Further information on liquid helium superfluidity is given by Hallock.[28] For a NASA-assigned patent that attempts to make practical use of this effect, see Reference 29.

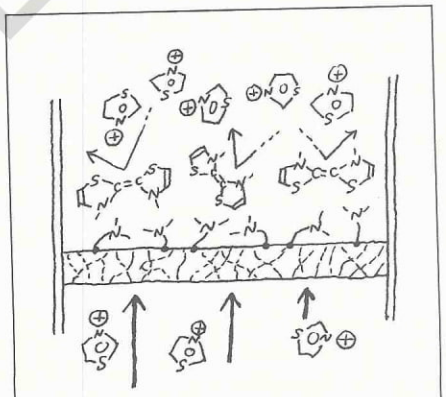

Fig. 9

True scientists should not have any objection to a proliferation of computer models that demonstrate anti-Second Law systems. Truly objective people understand that in scientific matters, the truth can suddenly become a moving target. The astronomers of Galileo's era (who refused to look through his telescope) were more true believers than true scientists. It may well turn out that simulations of tethered-solute osmosis will become the thermodynamic equivalent of Galileo's telescope.

Experimental scientists—finally won over by simulation results—might still decide to "take it slow" in terms of scaling down the Figure 7 "new osmosis simulator." If such proves to be the case, I am firmly predicting that they will find that the smaller they make their general "tethered-object" membranes, the less need there will be to supply active shaking. Ultimately, at the smallest nanoscale (molecular), *no active shaking input* of any kind will be needed. That is *my* prediction.

Stepwise shrinkage of the Figure 7 macrolevel demonstrator will force skeptics to put out a specific size range at which they think the general tethered-object process will stop working. People must be compelled to get down to brass tacks as to just where they think the breakpoint is as the actively-shaken macromodel is shrunk. This will give the experimental people in charge of making the Lilliputian machinery targets for confirmation or refutation. This is an entirely fair proposition.

The first stage of size reduction for Figure 7 will employ methods well-known in the art for using silicon as a mechanical material.[30] Patents that go back about fifteen years teach us how to make planar and microporous silicon structures that incorporate very tiny moving parts.[31,32] Also noteworthy is a more recent patent.[33] This will supply the substrate for using reduced-scale tethers to connect shrunken simulated solutes. Relevant to the tether requirement is a very recent announcement by Sandia National Laboratories concerning their creation of "microchains"[34] made of silicon. Each link is as small as a pollen grain—about 50 micrometers across. Silicon-based simulated solutes could be made from tiny silicon spheres. About ten years ago, Texas Instruments reported what they called "Spheral Solar Technology"[35] using such structures.

The combination of the above disparate silicon-based technologies is represented in Figure 10. One hundred percent active shaking will be needed at this level. To this end, it seems most practical to use some type of piezoelectric vibrator as the shaker.

After micromechanics employing silicon has been pushed to its lower limit, a method that lends itself to spanning the gap between micro and nano can be introduced. It will demand a fusion of the following technologies: track-etched (nucleopore) filters with hole linings made of electroless-deposited gold,[36] loose chains made of rotaxane polymers (in which "monomodified"

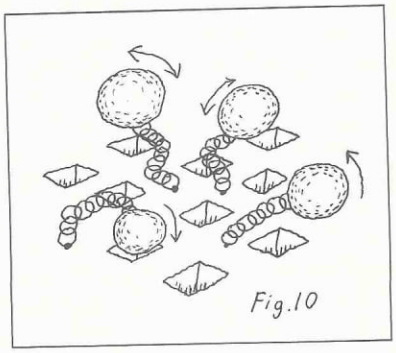

Fig.10

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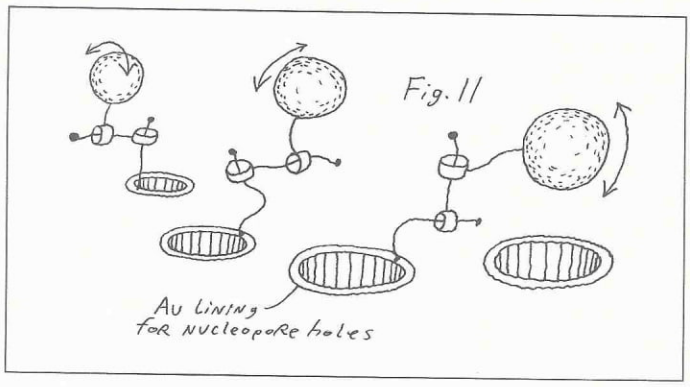
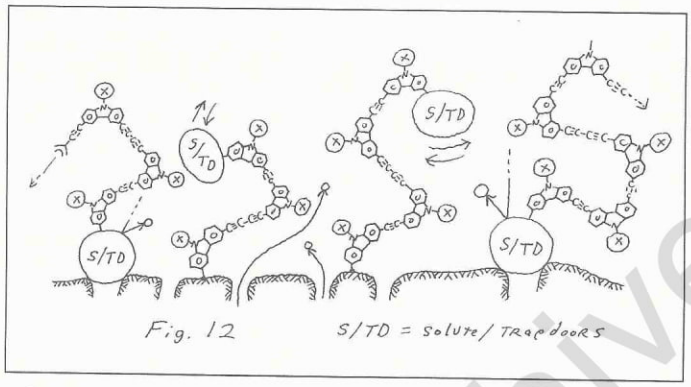




cyclodextrin rings spontaneously thread themselves onto long-chain molecules like polyethylene glycol),[37-42] and size-controlled "Stober silica" colloid particles[43-45] as simulated solutes. As shown in Figure 11, the rotaxane-style interpolymer junctions should minimize rotation barrier issues, thus maximizing chain-tether flexibility.

For the sake of completeness, it is important to note that "duplex" (double-helix) DNA can be successfully "looped" using 34-mer single-chain nucleotide rings.[46] This could be important to know since there exists extensive experience with respect to the surface-attachment of DNA for sensors and sequencing.[47-49]

No matter what type of polymer is selected for anchoring to the annular gold regions on the nucleopore surface, a monofunctional ratio of one tether/one hole could be more or less assured through the use of bulky pretreatment functions; the reference of note specifies dendrimers as spacers.[50]

At the lower limit of what this method has to offer, it should be possible to pick up the beginnings of self-powered osmosis; only minimal external shaking might be needed. Stober silica particles can be made as small as a few hundred Angstroms in diameter.

Figure 12 shows the fully self-powered endgame. Here we see blissfully stupid solute/trapdoors (S/TD) tethered using chains incorporating diaryl acetylenes (tolan) and diaryl diacetylenes. The idea is to prove my theory that there exists an "Equivalence Principle" with respect to my brand of osmosis: a membrane cannot tell the difference between loosely tethered and untethered solute molecules. I noted in the prior paper my belief that the specified junctions will provide a zero rotation barrier. This is important if experimenters expect the tethers to exhibit facile mobility at room temperature. At ambient, the average energy available to surmount barriers is around 600 calories per mole.[51] It is here that I felt the need to update and better qualify assertions made in the prior paper concerning rotation barriers of the relevant acetylene-containing molecules.

According to a 1989 simulation study performed using the facilities at the Minnesota Supercomputer Institute,[52] diphenyl acetylene ("tolane") has a barrier of about 600 calories per mole. Calculations indicate that this arises from some measure of conjugation between the acetylene-separated rings. The "zero-energy" geometry is where the phenyls are coplanar. Compared with nearly all other compounds, 600 cal/mole is an exceptionally low value. Independent measurements that tend to support these simulation results were reported in Seminario *et al.*[53] and Okuyama *et al.*[54]

On the other hand, an ideal zero barrier is almost certainly present for the Figure 13 diphenyl diacetylene. My basis for confidence emerges from three somewhat inaccessible references reported in one of the excellent Patai functional group reviews that appeared in 1983.[55]

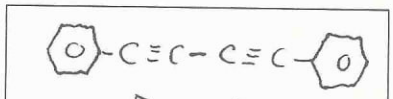
Experimenters need to be forewarned that tinkering with compounds incorporating the acetylene function is not without drawbacks. This derives from the great energy stored in the carbon-carbon triple bond. It is not without reason that unsubstituted acetylene (gas) is used to supply combustion energy for melting steel.

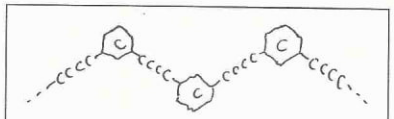
It was reported in 1988 by Neenan and Whitesides[56] that deprotected ethynyl aromatics used to create the Figure 14 polymer along with associated oligomeric materials are to be treated as potentially *explosive*. Volatile monomers should be distilled under high vacuum at <60°C in *well-shielded equipment*. The Figure 14 polymer starts to crosslink/decompose at temperatures above 150°C.

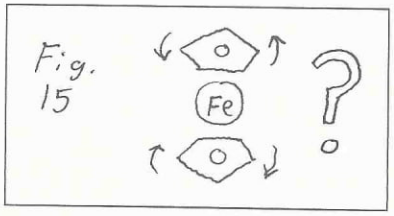
Except perhaps for the rotaxane scenario (see Figure 11), I don't see much of an alternative except to learn to work with acetylene-bearing organics.

Some might suggest that the cyclopentadienyl (cp) rings of ferrocene (Figure 15) could be used to provide tether-chains of very high mobility. Such hopes are not sustainable based on a 1963 report by Mulay and Attalla[57] stating that the activation energy for ring rotation in unsubstituted ferrocene is estimated at 2.3 kcal/mole. This energy (pivoting stiffness) increases with increasing substitution on the cp rings. Use of ferrocene would not present anything like the instability hazard of acetylene-containing materials.

My membrane machinations provide mankind with basic insights as to how the Second Law can be *experimentally* tested. This is actually something new for this scientific law. All the other laws of physics are routinely tested through experiment: Newton's laws, quantum mechanics, the assertions of particle physics and relativity. In the history of science, it has often proved to be the case that theory jumps well ahead of the tools available to experimenters. General relativity is a prime example of this. In some cases, it required many decades to arrive at observa-







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tions of exotic astrophysics (undreamed of by Einstein) before predictions of things like black holes and gravitational radiation could be checked. In fairness to the founders of thermodynamics living in the 1800s, they could not imagine the modern methods of numerical simulation and nanotechnology that now offer hope of "getting in between the nonuniformities"[58] and thereby finally showing the limits of the Second Law. During much of the nineteenth century, what passed for "material science" was only two notches above the Stone Age (the most advanced polymer was leather until Goodyear's breakthrough). At least many members of that earlier generation were honest enough to admit that they could not *prove* that random motion at the molecular level could not be harnessed. For a historical review of this period, see the 1970 paper by Klein.[59]

With seemingly no provable counterarguments, the Second Law precipitated its way into textbooks, whereupon it was transformed into petrified Holy Writ. My religious tone is intentional. In our day, the glorious Second Law is preached around the world by luminaries ranging from energy consultant Amory Lovins to Steven Hawking and every tenure-propped blackboard jockey in between. There are now reputations at stake! The Great Oz has spoken! One thing you had better believe is that the "Conformity Force" is every bit as real as gravity.

Molecular Ratchets

A.P. Davis in 1998[60] echoed the above sentiments, his statement providing a transition to an extensive discussion of *molecular ratchets*:

> To challenge the Second Law may be seen as scientific heresy. . .However, as scientists we should take the view that *nothing is sacred* [emphasis added], that experimental results outweigh all theoretical considerations, and that it is quite appropriate to revisit old questions as new techniques become available.

The Davis reference constitutes a short review of the (so far) unsuccessful history of attempts to synthesize molecular ratchets able to "rectify" molecular randomness.

Given the fact that the "state-of-the-art" of such nano-contraptions is represented by the Figure 16 molecule, it is not surprising that nothing useful has (thus far) happened. This molecule was reported by Kelly and his team of chemists.[61,62] In my prior paper, I justified my doubts in the following way:

> My own view of the negative results [the triptycene component rotates clockwise and counterclockwise to the same extent] is that if you built a macro-sized model of the [Figure 16] molecule and placed [it in a] shaker chamber filled with test particles simulating a Brownian fluid environment, the result would be the same: no net rotation.

Very recently, I discovered in a peer-reviewed journal article written by Kelly himself[63] that he basically admits that the Figure 16 design was doomed to "crash and burn": ". . . the barriers to clockwise and counterclockwise rotation are the same, and [Figure 16] *could never have functioned as a ratchet* [emphasis added]."

As the Kelly team of nanochemists head back to the drawing board, something they might want to consider for their next project is a variant on my proposal given in my prior paper. Reproduced here in Figure 17, it consists of a rotaxane association between a triptycene and a helical "Lockwasher molecule." A review on so-called "helicenes" is available.[64]

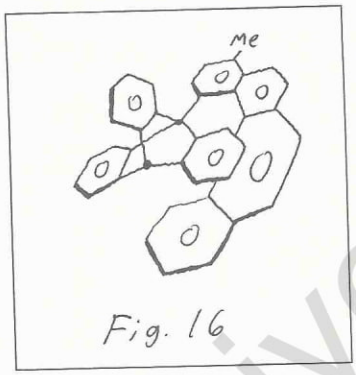

Fig. 16

My research turns up the fact that workable macrolevel equivalents of the Figure 17 gizmo have been in the public domain for over ninety years. If you want proof, take a look at U.S. Patent Class 185, Subclass 30 (motors, irregular motion). When you dig deep enough down the list (expect to encounter a lot of schemes for harnessing ocean waves), you come across a 1911 patent by Huckle.[65] I consider this one to be of primary interest. It describes "paddlewheels and helix vanes. . .extending into the path of one or more balls. . .free to move on the floor of a casing." The patent specifies that the casing may be freely vibrating or oscillating. The intent of the inventor was to rotate advertising messages on the backs of cars. The roads sure must have been bumpy in that earlier era!

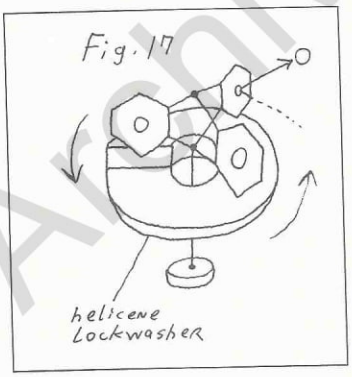

Fig. 17

If the Figure 17 triptycene/helicene rotaxane cannot be workably scaled down to the *molecular level* (as Second Law zombies will robotically insist), then it becomes fair to ask *exactly* what is the dimensional level whereupon it suddenly no longer functions. This is the same reductio-reasoning I applied to the Figure 7 tethered-solute osmosis demonstrator. Operational disfunction must occur at some level well short of molecular/nanoscale. Otherwise, the Second Law will be violated by yet another mechanism!

The late physicist Richard Feynman was not a fan of molecular ratchets. He firmly predicted in the 1960s that they cannot work.[66] In reference to Figure 18, he reasoned that this ratchet-and-pawl weightlifter cannot operate when the temperatures "T_1" and "T_2" are equal. His disciples preach the same gospel. This can sometimes involve circular reasoning, as represented by the following quote from a recent patent:[67]

> Similar to Maxwell's demon, the Second Law of Thermodynamics cannot be violated by [Feynman's "ratchet and pawl"] because one cannot extract work from background white noise.

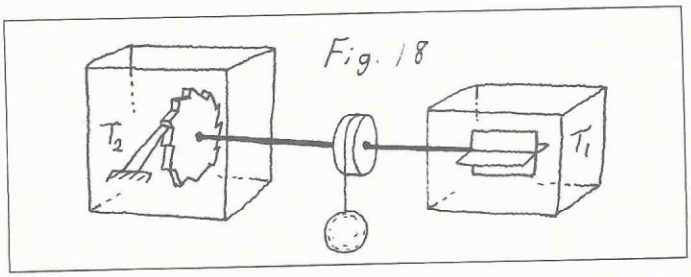

Fig. 18

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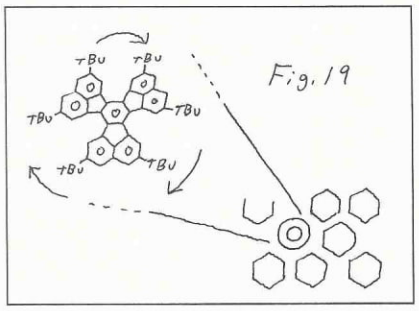

The patent the quote comes from was assigned to IBM. Their scientists seem to be intrigued by the propeller-shaped "HB-DC" molecule that was observed to be spinning while pivotally fixed to a surface. This is according to scanning tunneling microscope (STM) observations reported in *Science* in 1998.[68] See Figure 19.

I mentioned HB-DC and the *Science* reference in my first article. I also implied that (as supported by a quote from the *Science* reference) there is a distinct possibility that the reason for its spinning is because it is responding to its environment like a Brownian-driven self-winding watch. After pointing out in my prior paper that you can see all kinds of patents on such watches under U.S. Patent Class 58 (horology), Subclass 82 (self-winding watches), I offered the following question: "What is wrong with self-winding nanowatches?" Others seem to have wondered the same thing; see Parrondo and Espanol[69] for a rare peer-reviewed critique of Feynman's comments. In their conventional embodiments, macroscopic wrist fluctuations supply the drive for self-winding timepieces.

There was an inconsistency in Feynman's attitude. Here we have a man who could be against molecular scale ratchets while at the same time he supplied (in the form of a talk printed in a 1961 book[70]) one of the most-cited references in the literature on nanotechnology. His talk was titled "There is Plenty of Room at the Bottom." Many people (including the late, great Feynman) seem *highly selective* as to what the "bottom" has room for.

Perhaps the next most important foundational nanotechnology paper was published in 1981 by K.E. Drexler.[71] Drexler is presently the leader of an organization called The Foresight Institute. As such, he promotes the view that essentially *any macrolevel mechanism* can be shrunk down to the nanolevel. At least that is what he claimed based on the table of Figure 20 that is borrowed from his article.[71] I have also borrowed a quote from this paper that should be of interest to designers of self-winding nanowatches:

> We commonly accept the feasibility of new devices without formal proof, where analogies to existing systems are close enough: Consider the feasibility of making a clock from zirconium. The detailed design of many specific devices to render them describable by dynamical equations would be a task of another order (consider designing a clock from scratch) and appears unnecessary to the establishment of the feasibility of certain general capabilities.

DeMara *et al.* in the journal *Nanotechnology*[72] described a "helical latch" device specifically intended for molecular-level implementation. The authors wanted to use it in nanocomputers, but hopefully they won't mind if something similar (see Figure 17) ends up *powering* their computers.

The 1981 Drexler paper mentioned the need for an "assembler." He envisions this as a device able to carry out massively-parallel mechanosynthesis on the basis of position alone. He provides some degree of elaboration in a 1994 paper.[73] I would now like to use the current venue briefly to call attention to the fact that I have laid the conceptual foundation for something similar. I call it a "nanopantograph." I offer self-published documentation concerning its configuration and capabilities.[74] It is of special interest for customized construction of "polyvalent" drug molecules.

Fig. 20

Comparison of macroscopic and [nano]scopic components

Technology	Function	Molecular example(s)
struts, beams, casings	transmit force, hold positions	microtubules, cellulose, mineral structures
cables	transmit tension	collagen
fasteners, glue	connect parts	intermolecular forces
solenoids, actuators	move things	conformation-changing proteins, actin / myosin
motors	turn shafts	flagellar motor
drive shafts	transmit torque	bacterial flagella
bearings	support moving parts	σ bonds
containers	hold fluids	vesicles
pipes	carry fluids	various tubular structures
pumps	move fluids	flagella, membrane proteins
conveyor belts	move components	RNA moved by fixed ribosome (partial analog)
clamps	hold workpieces	enzymatic binding sites
tools	modify workpieces	metallic complexes, functional groups
production lines	construct devices	enzyme systems, ribosomes
numerical control systems	store and read programs	genetic system

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These could come in handy in the cure of major diseases.[75] This nanopantograph-assembler disclosure broadly applies since it represents yet one more Sad Sack example as to how the wheels have fallen off the Perpetual Stagnation Machine of Big Science. Too many scientists operate in corporations that are primarily concerned with non-groundbreaking "product extension" research (a.k.a.: "Making Paint Dry Faster"). Where there is no vision, the people perish.

The importance of Drexler's assembler or anything resembling it (such as Varner's nanopantograph) is critical to the advancement of nanotechnology. It is conceivable that such mechanosynthesis machines might be used to assemble molecular perpetual motion machines. In any case, the problem of resolving the issue of massively-parallel mechanosynthesis has been called one of the "Holy Grails" of modern chemistry. See Avouris[76] in *Accounts of Chemical Research*.

Also falling under the Holy Grail heading (according to Avouris) is the resolution of the use limitations of STMs and AFMs (atomic force microscopes). As I will explain, *there is no doubt* that progress here will directly boost the ambitions of those who seek perpetual motion based on Brownian-powered nanoratchets. A quote from Avouris pinpoints the primary problem with such devices:

> Currently, the biggest limitation in atomic and molecular manipulation [using STM/AFM devices] is the fact that the structure and composition of the tip used is not, in general, known or reproducible. . . There is a great need for tips with a well-characterized and stable apex structure.

At the present time, the most commonly used AFM tips are made of silicon nitride (Si_3N_4), square-pyramidal in shape, with a nominal radius at the apex (as shown in Figure 21) of about 300 Å.[77] Such tips are too blunted for too many urgent applications.

The problem is a persistent one as witnessed by information in a 1999 issue of *Chemical Reviews*.[78] The most advanced concept for tip sharpening that was offered was to attach carbon nanotubes. This approach is said to be "very labor intensive." More effective procedures are said to be *eagerly awaited*.

This writer is able to assure concerned researchers that *your wait is over*. I have arrived at fully self-consistent procedures for reliably supplying "one-molecule-sharp" AFM tips. Drexler (and, I am sure, others as well) has realized the need for this for well over ten years.[79]

My information is currently unpublished/proprietary. I am looking for investors to help with the cost of patent protection and subsequent development. There are exceptionally important applications for such tips (biological investigations[80] and information storage[81]) that go beyond the scope of the present discussion.

Single-molecule AFM tips appear to be *essential* to resolving issues of "molecular tribology" (surface friction at the nanolevel). This bears directly on the making of *practical* nanoratchets.

A 2001 reference[82] concerned with the commercially extremely important problem of anti-friction monolayer coatings for hard drive computer disks provides insights into the limitations of current measurement methods:

> Very few studies focus on nanomechanical properties of nanometer-thick organic and polymeric layers due to the fact that this kind of measurement is a challenge *for any known technique*." [emphasis added]

Owing to (in my informed opinion) poorly-defined ATM tips, the few studies that are extant are as likely as not to give inconsistent results.[83-85]

After tip enhancement according to my proprietary procedures, more advanced AFMs possessing consistently oriented rigid molecular rods will easily be able to resolve the above tribology issues. For extra credit, these sharper AFM tips can evaluate frictional anisotropy with respect to crystal packing geometries that characterize certain plate-shaped molecules. I have in mind especially the phthalocyanine (Pc) molecule. For information on "tilted packing/herring-bone Pc structures" that hopefully could provide frictionally anisotropic "sawtooth surfaces," see References 86-88. Also of strong relevance are investigations into non-phthalocyanine surfaces such as carbon black[89] and anisotropic rubbed surfaces used for liquid crystal displays.[90-93]

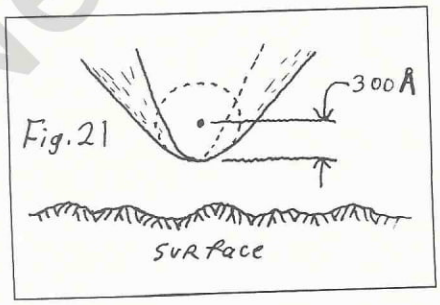
Figure 22 shows a speculative procedure in which anisotropic friction is directly observed with respect to a surface consisting of a row of shingle-arranged/fallen domino molecular nanoplates. A *single-molecule* Varner-modified AFM tip will be essential.

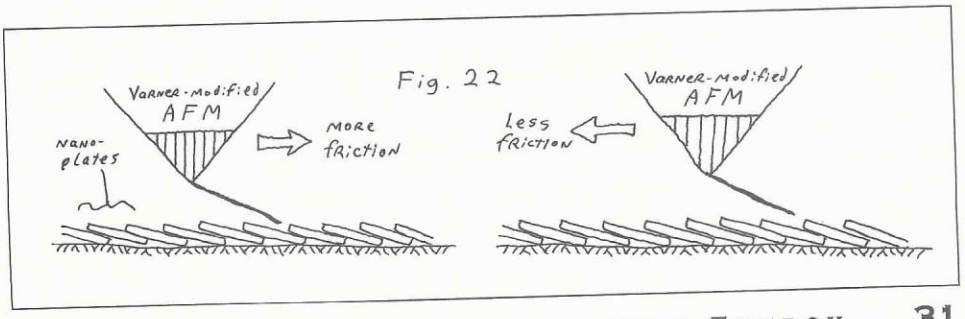
I am hopeful that such investigations will open the door to making practical a novel way of "wiring up" trillions of independently-moving nanoratchets. The alert reader will recall that I mentioned in my prior paper the seemingly intractable massively-parallel "output-summing" problem of deriving power from such things. I gave a supportive reference that applied to certain silicon-etched micromechanical concepts that use conventional thermodynamics.[94]

The best hope seems to be to employ *triboluminescence*—in other words, the direct production of light through mechanical interactions. I intend to design ratchets that glow in the dark! A review on triboluminescence was given by Sage and Bourhill in 2001.[95]

By way of background, it is the normal circumstance to display this behavior by fracturing crystals of various kinds. If nothing beyond such "bulk effect" emissions existed, there would be an immediate end to this line of inquiry.

A fact of key importance to the making of glowing ratch-





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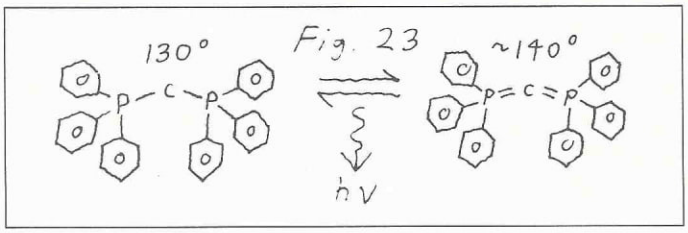


ets is the existence of at least one molecule that can be repeatedly and reversibly bent to energize it for repeated cycles of light production. Figure 23 shows this molecule. Its name is hexaphenylcarbodiphosphorane. After this, I think I will refer to it simply as the "Figure 23 molecule" or "Figure 23." For a detailed structural study that displays its bent geometry, see Vincent and Wheatley.[96]

One constraint on the use of Figure 23 is that it is moisture sensitive.[97] This is simply an operational issue; it will mean that any gathering of ratchets using Figure 23 will have to be hermetically sealed.

A much more constraining issue is the energy threshold needed to induce the "130°/140°" bending cycles. The review by Zink[98] gives this as *12 kilocalories per mole.*

Right away, the perceptive reader understands that a single nanoratchet (for example, see the Figure 17 rotaxane version) will be hard-pressed to supply such energy. Excluding the prospect of using nanogears or some type of nanolinkage to improve mechanical advantage/leverage, the best a "direct drive" interface could deliver would be a scrawny 600 calories per mole.[51]

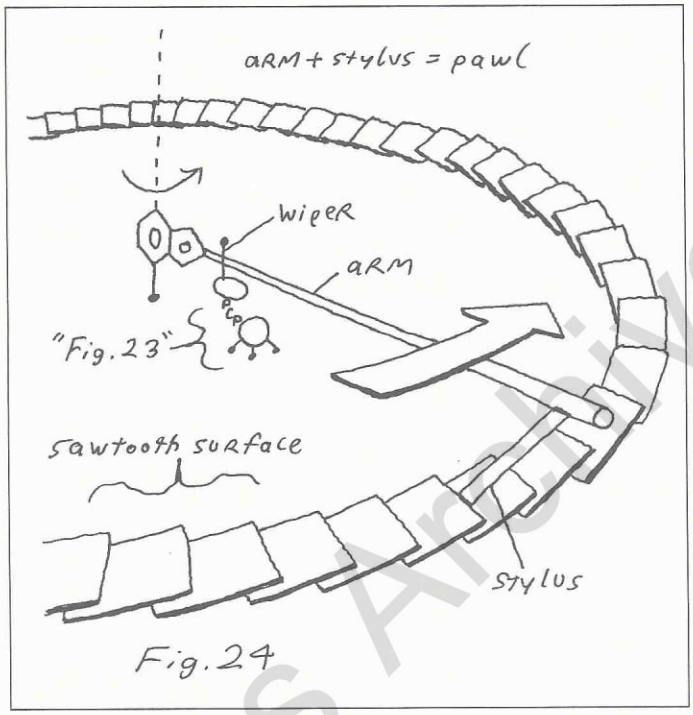
As an aside, let me insist here that enzymes have long been suspected of using some type of hard-to-pin-down Brownian leverage trick for cleaving molecular connections. A number of references feed this suspicion.[99-103] Accordingly, my mention of possibly doing the same trick in an artificial context is not without some measure of prior history.

Baseline experiments on suitable "leveraged nanoratchets" could employ the general machinery of Figure 24. Here we see a centrally-pivoted arm that is mounted on any suitable substrate. It is subject to Brownian jiggling. For reviews by Cherry and Russel dealing, in part, with the rotary Brownian diffusion of colloid-size particles confined in two-dimensional surface layers, see References 104 and 105. The arm jiggling is at its most extreme at the outer end, to which is connected a stylus that engages the sawtooth surface. The random jiggling is ratchet rectified to produce one-way motion. A Figure 23 molecule is attached in some way near the center so the arm can exert maximum leverage on it in the hope that it will put out some photons as the arm "tweaks" the wiper that is attached to said molecule.

Before adding more detail, I should mention that based on experiments with cantilevered carbon nanotubes reported by Treacy *et al.* in 1996,[106] it is possible to exactly quantify the degree of arm shaking that can be expected at room temperature.

For such extremely stiff structures, a 50,000 Å long, 80 Å diameter nanotube will display a vibration amplitude of 100 Å. See Figure 25.

I propose that the same principle will apply to smaller diameter monodisperse rods useful for fabricating arms. These will be less stiff (show more vibration) for a given length. Synthesis information is readily available.[107-111] Both the arm and the



stylus of the baseline Figure 24 machine will be made of such rigid rod polymers. Arm + stylus = pawl.

Prior work on substrate-mounted rotating nanomachinery is actually fairly common. The immobilized ATPase enzyme shown in Figure 26 bears a close family resemblance to the Figure 24 monoarm mechanism. ATPase is very commonly found in cell membranes. It can be modified with actin filaments and fixed to glass plates.

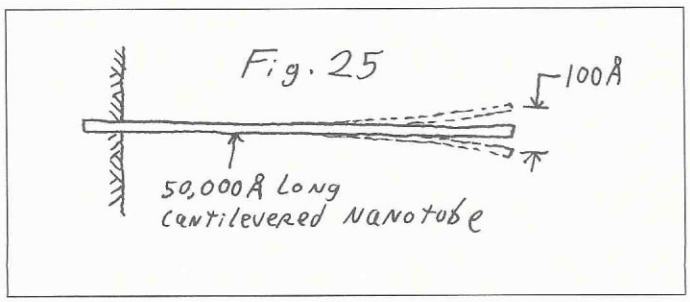
This biological motor rotates in one direction only: counterclockwise (as seen from the "membrane side"). Maximum rate of revolution is 240 rpm.

Noji[112] makes clear that this machine directly transforms chemical energy into mechanical energy (somehow!): "When ATP was absent, there was no rotary motion apart from the Brownian fluctuation, which, on rare occasions, accumulated over several minutes into a few turns in either direction." For a 1997 review of this chemomechanical wonder, see Boyer.[113]

Figure 27 shows a "propeller compound." According to a 1995 article,[114] it is proposed by Michl that it can be made to spin by subjecting it to a helium gas flow or by exposing it to microwaves. For similar information on similar substrate-mounted artificial rotors, see References 115-120.

The following "vision statement" is derived from the final reference in the above list:

> We see no reason why more complex structures and moving machinery could not be assembled from the same construction elements eventually, and it



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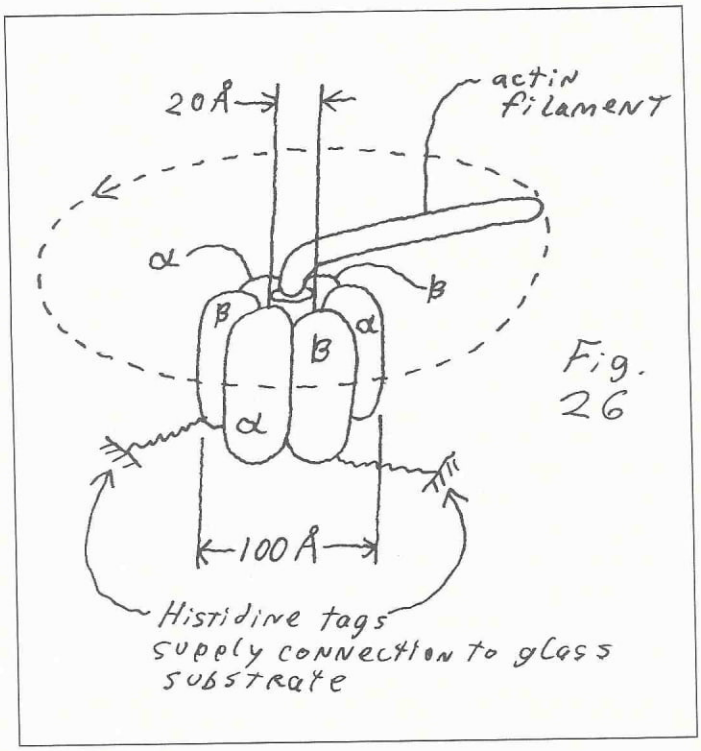

Fig. 26

does not take much imagination to foresee a surface covered with molecular-size swings or windmills generating electromagnetic radiation in response to a jet of gas ("molecular mobiles").

A big hang-up with the construction of *Brownian-powered* molecular mobiles lay with creation of the sawtooth surface of Figure 24.

There exists some measure of existence-proof for the circular sawtooth surface. The reader is advised to consider a reference discussing "porphyrin wheels" that appeared in 1996.[121] It has been proven that under the right conditions, *ring-shaped deposits* of overlapping plate-like porphyrins can be deposited onto substrates. These are considered to have a well-defined "shingle-like" pattern that is of strong interest for our purposes. Unfortunately, dimensions are hard to control. Diameters are "polydisperse" (in the 10,000 Å to 50,000 Å range).

As I take the next step beyond the Figure 24 mono-armed baseline, I intend to map out a plausible pathway for making precisely-dimensioned "rectifying ratchet rings" having the needed sawtooth configuration. The design will feature multiple pawls (as many as sixteen) consisting of multiple arms bearing multiple styli. They will share a common pivot point in an overall "merry-go-round" configuration. It is my expectation that the resulting team effort will enable the 12 kcal/mole bending barrier of Figure 23[98] to be easily surmounted. This theoretical confidence is constrained by the fact that there are gaps in terms of relevant chemistry, as reported in the literature. Nevertheless, I will not allow the perfect to be the enemy of the good.

The multi-arm merry-go-round machine to be presented can be broadly considered as a kind of "Brownian antenna" for boosting the 600 cal/mole thermal energy of the ambient environment. A related concept is embodied in Figure 28.

As made clear by the work of Jiang and Aida in 1997,[122] low-energy infrared radiation can be funneled into the central azo group of Figure 28 to greatly promote its isomerization from a higher energy "cis" state (in which the azo N = N bond is bent) to the more linear "trans" conformation shown. IR radiation has no effect on smaller versions of the Figure 28 system (lacking dendrimer antennas). For more information on "energy funnel" effects in light antennas, see References 123-125.

It will be most practical to mount our "Brownian funnels" on the flat surfaces of very tiny colloidal plates. Such a concept will allow the harnessing of random motion in a three-dimensional volume of fluid. This is expected to provide a significant advantage in terms of available power density (watts per unit weight) compared with a trapdoor membrane (Figure 12). The latter process can only function in a two-dimensional format. Kinetic theory tells us that at 1 atmosphere, a 3.5 Å diameter area of surface will get hit four billion times every second by gas molecules moving at velocities averaging around the speed of sound. Going from an "area format" (membrane) to a "volume format" (ratchet suspension) allows (in principle) massively-parallel access to such an energy resource. Trillions upon trillions of ratchets could be concentrated in a single cubic centimeter of fluid.

At the time of this writing, I believe the most practical source of colloidal platelet nanoratchet substrates is to use particles of kaolinite. This is a type of aluminosilicate mineral found in clay. As witnessed by the content of a number of very recent patents, it is possible to surface-treat kaolinite platelets to make them receptive to the attachment of functionality.

In my opinion, the water vapor plasma treatment as taught by Comalco Aluminum of Australia[126] is the most useful. As shown in Figure 29, the H_2O plasma opens up the aluminosilicate surface to give reactive hydroxyl sites. This is followed by conventional chemical (non-plasma) treatment with monochlorosilanes plausibly having a variety of organic substituents, thus providing a reactive interface. Documentation on silanation of inorganic colloid surfaces is abundant and includes References 127-131.

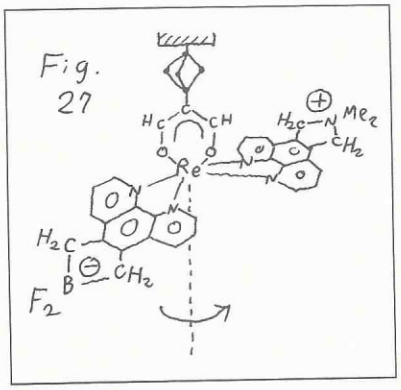

Fig. 27

With respect to creation of surface-functional kaolinite, of secondary importance (in my opinion) is the chemistry disclosed by AMCOL International in three U.S. patents.[132-134]

At least in the early stages of processing, the use of TEP (triethylphosphate) should be highly useful for maintaining solubility of the inorganic particles in an organic solvent. This technique is borrowed from Nechifor *et al.*[135] For related work by

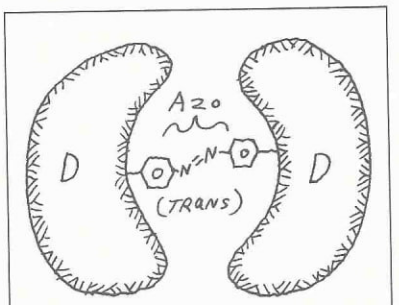

Fig. 28

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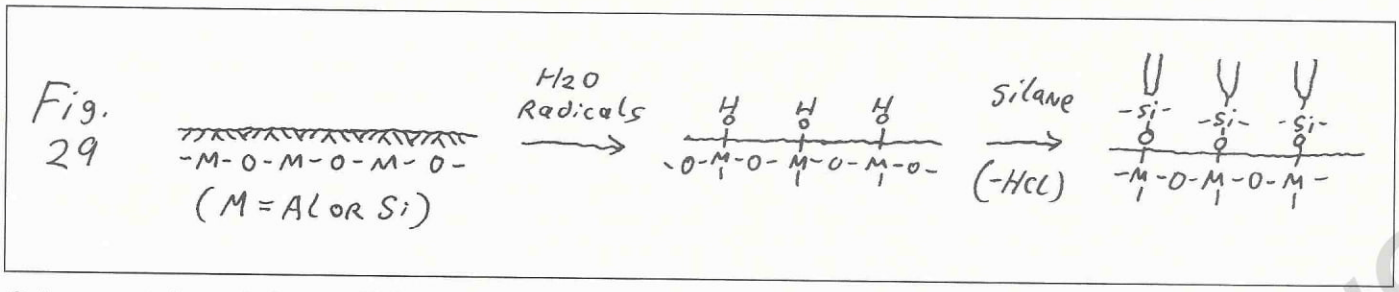


Guimaraes *et al.*, see Reference 136.

A surface that is merely silanated (see Figure 29) will be less stable than we prefer when exposed to acid/base conditions that deviate much from pH7 (neutral).[137] It is preferred that the platelet substrate precursor be seal-coated in some way with something more inert. The inert layer of choice will be based on zirconium phosphonate chemistry. This chemistry has a rich history.[138-142] As Cao *et al.*[141] and Neff *et al.*[142] make clear, layered metal phosphonates will be insoluble even in strong acids. Certain synthetic steps might well demand some degree of acid exposure.

Selection of exterior functions must take into account the need to stabilize the platelets against agglomeration/clumping. The large literature on colloid stabilization typically mentions use of electrostatic groups and surface-attached large molecules to promote steric repulsion.[143-146] A magnified view of the stabilized suspension up to this point should look something like Figure 30.

The next step will be to prepare sphere-shaped Stober silica colloids[43-45] as monofunctional carriers of what I shall term here as "hub assemblies" for the future "merry-go-rounds." The general appearance is shown in Figure 31.

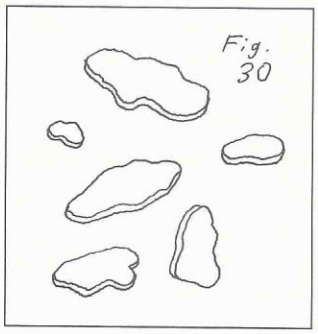
Before providing a magnified view of the hub assembly, I briefly note that with respect to preparation of monofunctional Stober particles, self-consistent procedures are given for this in my self-published report on "crystalline foam."[147] See especially Figures 100-102 of that report, depicting "docking" of a functionally receptive colloid at the bottom of an isolation "pit" enforced by a doughnut structure followed by cleavage from said pit and extraction of the monofunctional product using magnetic colloids.

The design of the hub assembly (based on phthalocyanine chemistry) also has deep roots in my crystalline foam report; see especially Figures 44-56 in that report. Figure 32, reproduced here, shows the detailed design for the hub. For purposes of illustration, many of the bonds had to be stretched a lot.

In general, I have in mind the use of a couple of oxo-bonded silicon-doped phthalocyanine heterodimers ("Stack A" and "Stack B" in Figure 32) joined in the middle using a biphenyl spacer. Stack A is more proximate to the colloid side and Stack B is closer to the so-called "landing gear" that will interface with the flat surfaces of the Figure 30 platelets. General references pertaining to the Figure 32 phthalocyanine (Pc) chemistry are References 148-154. References relating to the "caltrop-like" landing gear include References 155-159.

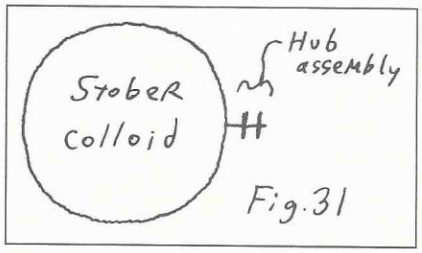
The next step will be to create a "heteroaggregate" by combining the Figure 30 plates with the Figure 31 colloids. The targeted result is shown in Figure 33. Similar aggregates have been created by dumping together large colloids of one charge with smaller-size colloids of opposite charge. It happens that the smaller charged colloid particles will automatically space themselves apart on the surfaces of the larger ones, owing to mutual electrostatic repulsion. Various references document this example of self-assembly in nanotechnology.[160-164]

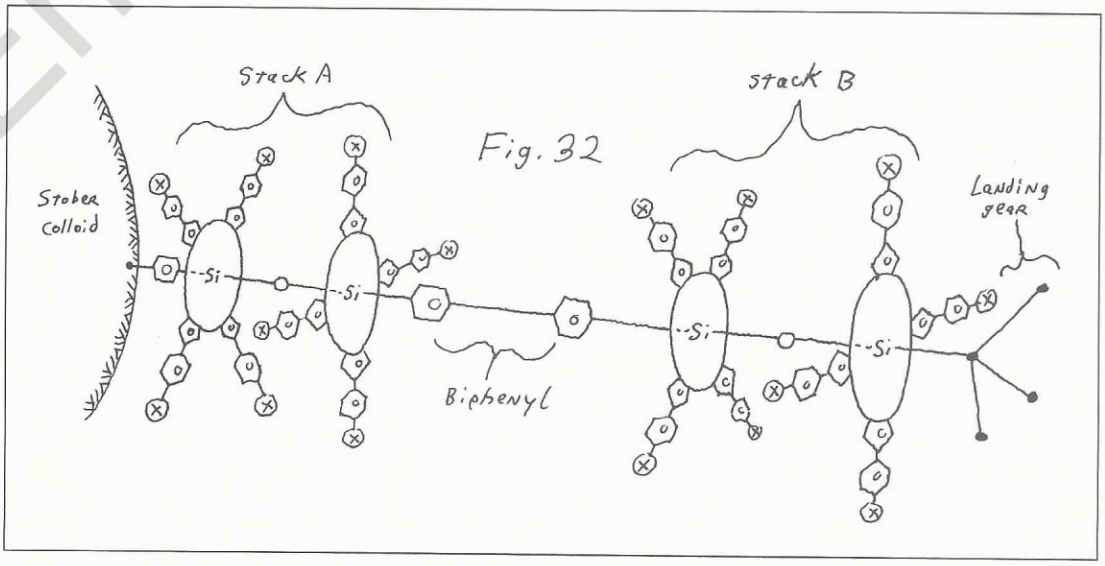
Assuming highly stable amide chemistry is used to connect Stobers with platelets, appropriate amide-forming reagents documented in the literature[165] can be used to create permanent bonds.



After covalent enforcement of the Figure 33 heteroaggregate, we can get down to the business of building onto the hub assemblies.

After cross-coupling monorods[107-111] at the radially-projecting "X" positions (see Figure 32) on the hub assemblies, they are terminated with Figure 34 cis-bisben-





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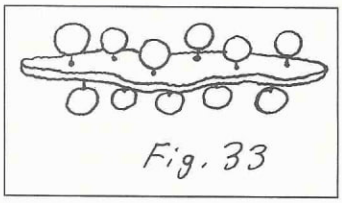
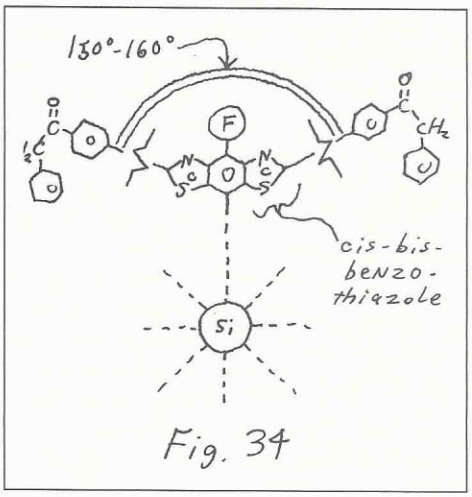
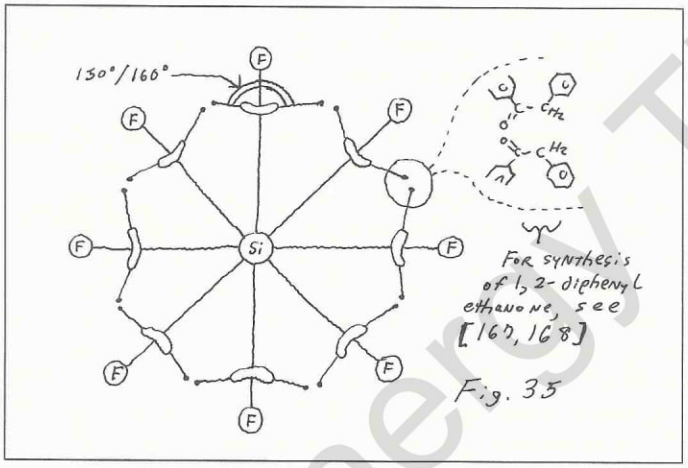




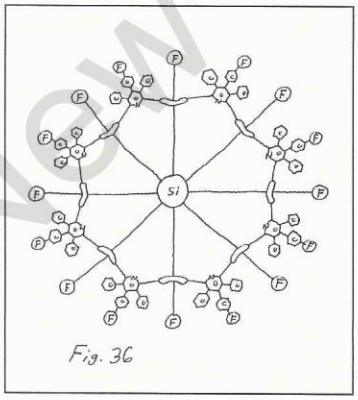
zothiazoles. These molecules have the right 150°-160° crescent-shaped angularity[166] to yield (in my estimation) virtually strain-free Figure 36 hexadecagons after suitable treatment of the Figure 35 eight-armed "spider" precursor. There will be two such hexadecagons for each hub assembly, one centered on Stack A, the other on Stack B.

References relevant to the fabrication of cis-bisbenzothiazole are associated with Figures 62 through 71 in Varner.[147] Pyrylium-style reactions for creating pentaphenylpyridine junctions between "crescents" are noted in References 169-172.

Let it be understood that without the steric hindrance provided by the Stober particles, the pyrylium-style crosslinking step giving the Figure 36 structure would yield a huge amount of polymeric and catenane (interlocked) material. This mode of



reaction isolation falls under the heading of *dispersion polymerization*. This is a long-known method used in the industrial manufacturing of polymers and yields free-flowing product in situations that would otherwise yield a reactor full of gummed-up paste.[173-176] Also relevant are reports of closing extremely large organic rings on site-isolated solid phase supports[177,178] and through the use of central templates.[179-181]



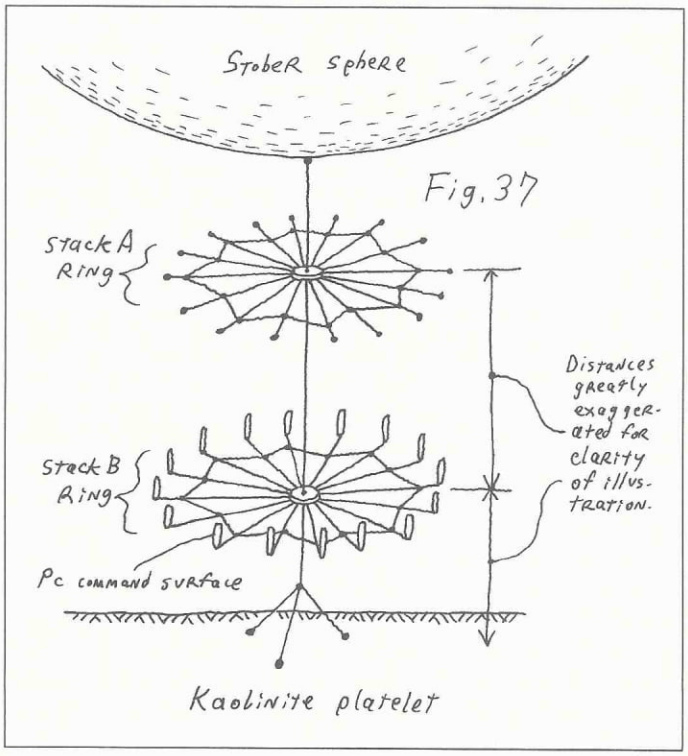
The synthetic effort now enters a Twilight Zone of uncertainty in terms of how much cooperation Mother Nature will offer. The previous steps will be a breeze by comparison. It is here that I provide my personal "Best Mode" estimation concerning manufacture of the nanodimensional sawtooth surface. The surface will be cylindrical and not annular, as was the case in Figure 24.

Figure 37 shows the next step in the development of the ultimate molecular merry-go-round: Use the radially-projecting "F" functions on the Stack B sixteen-member ring (in closest proximity to the platelet surface) to attach Pc-based "command surfaces." Their upright orientation in the circular array will yield a product looking something like the Stonehenge monoliths.

The term *command surface* comes from a 1993 report by Seki *et al.*[182] They demonstrate how it is possible to use a monolayer of oriented surface molecules to control the orientation of a much greater bulk of liquid crystal molecules that were in near proximity. Also germane are papers dealing with certain types of polymer-micelle interactions[183,184] and a reference by Simon and Bassoul[185] on "submicronic" Pc-based liquid crystals.

The highly specialized design of one of the Pc-based command surfaces is shown in Figure 38. References relevant to their fabrication include References 186-204.

Isolated-site solid-phase chemistry will play a key role in the fabrication of the Figure 38 Pc derivative. This is especially true regarding the bridged feature wherein the axial phenyl (bonded to the central silicon on the back side) is connected to the spiro-connected pyrazabole. An ideal medium for such isolated-site chemistry (that goes beyond the present state-of-the-art) is a polymer consisting of highly expanded molecular dodecahedrons. I offer a self-published document telling all about it.[205] Ring closure applications



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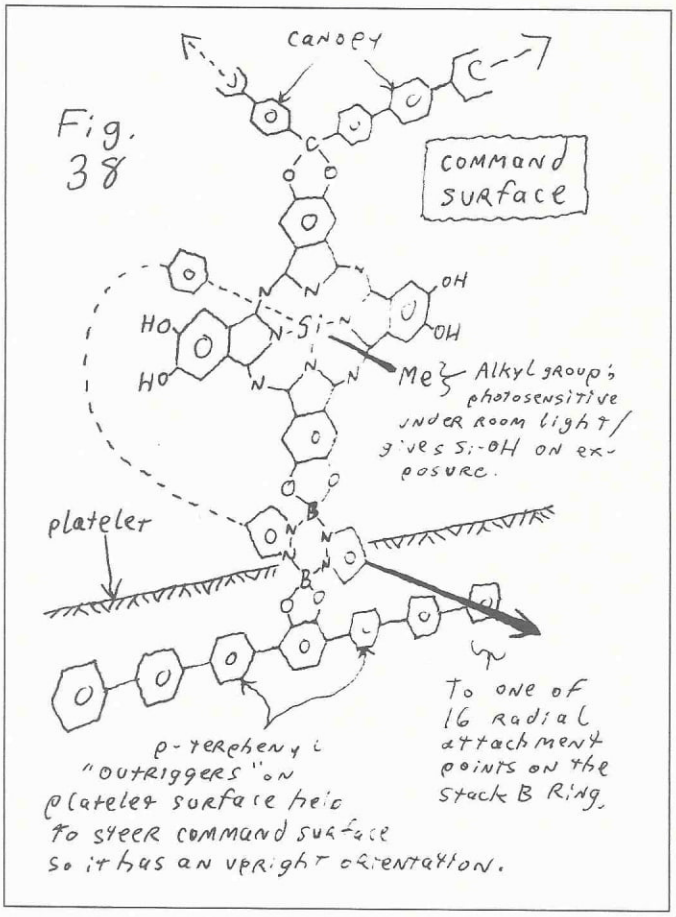

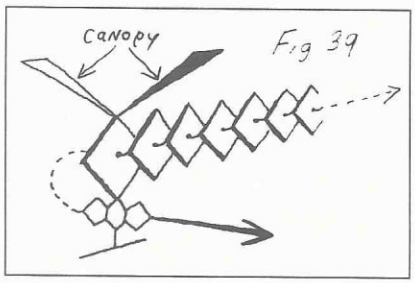

for this new type of solid phase medium that goes beyond the scope of the present discussion include manufacture of large lactone rings (having antibacterial implications)[206] and large protein rings of strong interest as anticancer drugs.[207]

As shown in Figure 39, the Pc command surfaces will act as anchor points from which will be grown in a stepwise manner[208] a series of linked plates. These plates will very likely also be Pc-based. For the sake of completeness, however, the potential use of alternatives including tetraazaannulene[209,210] and porphyrazine derivatives[211,212] cannot be fully excluded.

Figure 40 offers ideas for the specific interplate linkage chemistry; it might be either phosphorus-based,[213-216] boron-based,[217-219] or copper-chelated.[220-223]

There is no known precedent for the proposed chains 40 A,B,C,D.[224] Related structures showing coordination chemistry at the edges of a monomeric "tetracatechol" Pc were reported in 1998.[225] Also of supportive interest is the supramolecular structure of the coordinatively-bonded chain of cobalt-doped porphyrins shown in Figure 41 and reported in Michelson and Hunter.[226]

Figure 42 shows that after the linked plates have all reached *the same length* extending from the sixteen command surface anchor points (a critical assumption!), the molecular pinwheel is cyclized to give the basic cylindrical ratchet surface. Pinwheel-mode cyclization of smaller rings is supported by literature reports.[227-229]

The above presupposes that the plates can be made to extend in a synchronized, consistent direction, either clockwise (as shown) or—just as usefully—counterclockwise. There is *fundamentally* not a problem in achieving consistency. A chemist will need to employ *chiral auxiliaries* mounted on the sixteen attachment points provided by the Stack A ring. For information on prior work with such stereo-directing compounds, see Suzuki *et al.*[230] In this situation, it seems most appropriate to use bulky dendrimers bearing benzyl alcohol groups that can easily be made to form benzyl aryl ether connections with the catechol functions of the Pc command surfaces. Such a reaction will use dehydrative Mitsunobu chemistry.[231,232]

Figure 43 shows an "unrolled" version of the particular Stack A/Stack B stereo-specific interface I have in mind. Since the dimensions of the sixteen-member Stack A/B rings are consistent, the positioning of the dendrimer-based chiral auxiliaries must also be "in-phase."

Just before pinwheel-style ring closure, the chiral auxiliary dendrimers will be disconnected from the catechols (using TMSI[233]) and the Stack A ring. Assuming the latter were joined using a "Kapton interface" (see Figure 43), a number of well-understood selective and reasonably gentle reagents used in the electronics industry for "etching Kapton" can be used to cut it loose from the A ring.[234-236]

Prior to connecting the styli-pawls to the sixteen radial points on the A rings, it will be necessary to install a full canopy. See Figure 44. The ring-shaped canopy (based on extended diphenylmethanes spiro-connected to the plates of the ratchet ring) will serve to sterically confine the styli-pawls so they cannot flip around with respect to their installed orientations. A Suzuki-type reaction is preferred for installing the canopy extensions.

Assuming the ratchet plates are linked using phosphorus junctions (Figure 40A), Figure 45 shows the first step and subsequent steps in the oriented installation of a stylus. It is assumed to be initially "softdocked" at its ratchet-contacting end using a P-Cu dative bond.[237-240] Low temperatures are presumed to be needed to preserve P-Cu bond integrity.

The next step is to form an amide junction at the opposite end. The same "landing gear lock-in" reagent[165] can be used here. This can be considered an example of an "orientation-dependent" reaction.[241-243] Finally, a combination of simple oxidation[244] and acid hydrolysis breaks up the temporary P-Cu connection.

There will be an excess of styli available for reaction. The non-bonded styli will pass into solution and can be recovered/reused. As far as that goes, the Stober particles have become superfluous and could be cut loose (via oxidative cleavage of trans-stilbene junctions?[245]) and reused.[246]

The Brownian merry-go-round should now be turning! See the top view of Figure 46.

A study on a successful *macroscopic* rotary ratchet has appeared very recently in a well-known physics journal; see Norden *et al.*[247] An interesting exercise for the scientists involved would be to speculate as to what is the ultimate miniaturization potential of their gadget. Maybe they could be persuaded to do a computer simulation of the Figure 24 baseline nanoratchet.

The primary objection Feynman had to a nanoratch-

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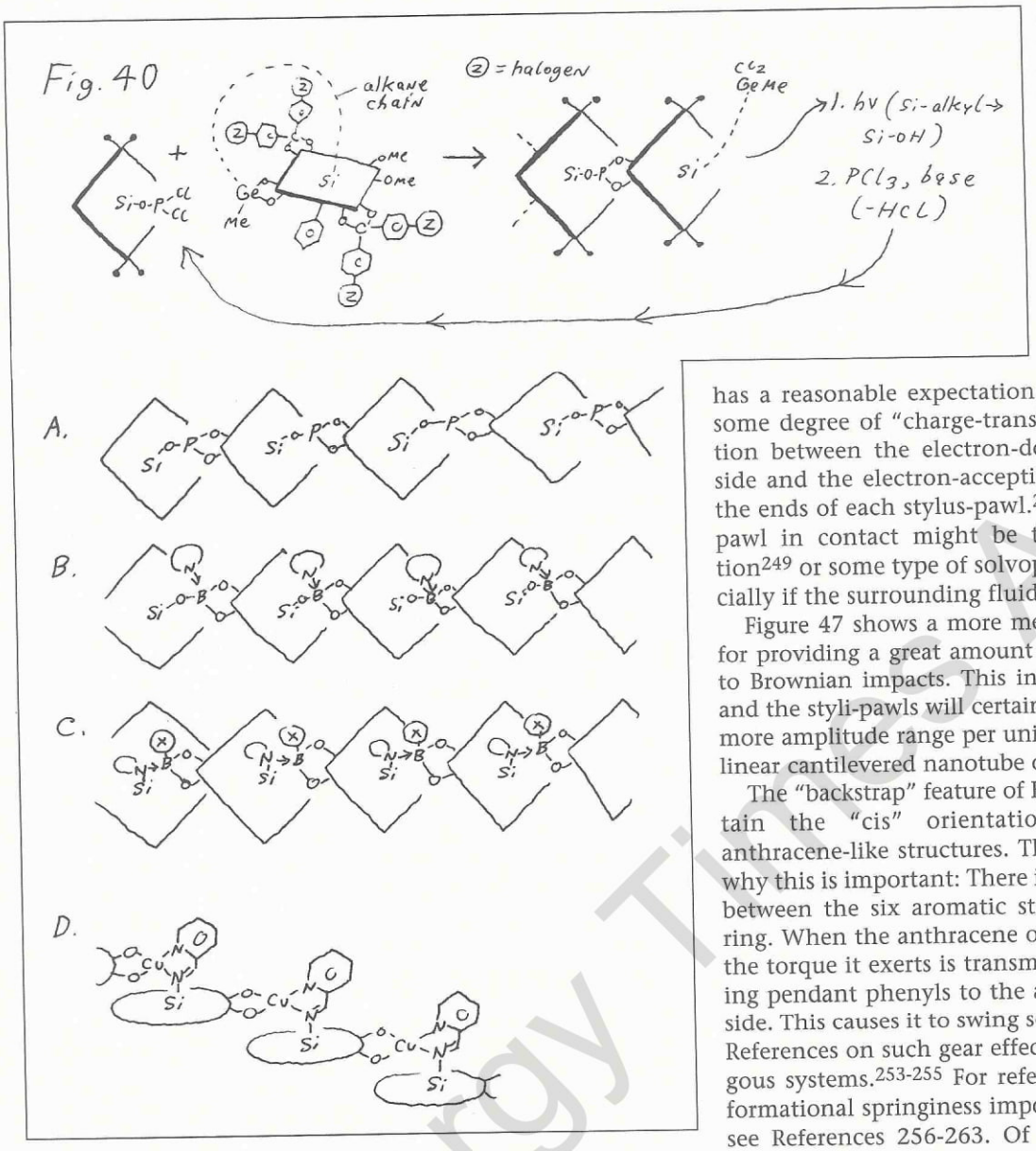

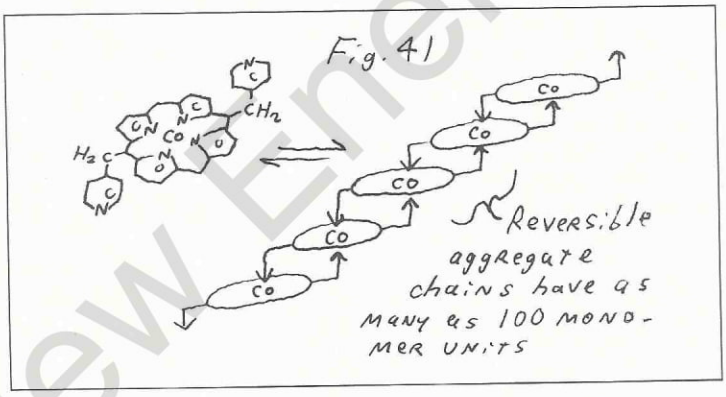

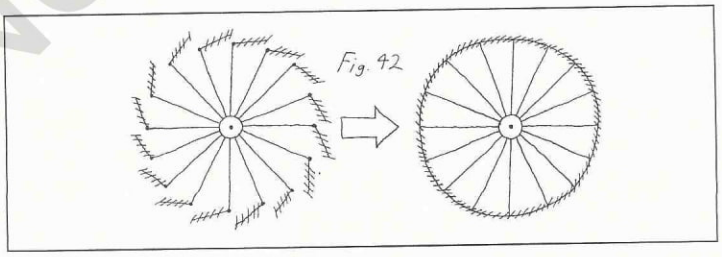

et[66] is that he imagined the pawl will shake too much under Brownian bombardment and vibrate free of engagement with the sawtooth surface. In my humble opinion, I consider this to be a "straw man." There is plenty of room at the bottom[70] for ways to negate this.

The Figure 45 design has a reasonable expectation of automatically offering some degree of "charge-transfer" self-assembly interaction between the electron-donating catechols on one side and the electron-accepting metadinitro groups on the ends of each stylus-pawl.[248] Other ways to keep the pawl in contact might be to use "cation-π" interaction[249] or some type of solvophobic interaction[250] especially if the surrounding fluid was a fluorocarbon.[251,252]

Figure 47 shows a more mechanically compact design for providing a great amount of springiness with respect to Brownian impacts. This interface between the A ring and the styli-pawls will certainly be able to provide much more amplitude range per unit of length than the strictly linear cantilevered nanotube of Figure 25.

The "backstrap" feature of Figure 47 is needed to maintain the "cis" orientations of the para-located anthracene-like structures. The view of Figure 48 shows why this is important: There is a "gear effect" interaction between the six aromatic structures on their common ring. When the anthracene on one side swings one way, the torque it exerts is transmitted through the intervening pendant phenyls to the anthracene on the opposite side. This causes it to swing so that the stroke is doubled. References on such gear effects are well-known in analogous systems.[253-255] For references bearing on the conformational springiness imposed on crowded molecules, see References 256-263. Of special relevance are what can be thought of as "crankshaft molecular structures." Two references are of interest: one derives from a liquid crystal study,[264] the other from studies on 2,6-bonded chains of quinoline molecules.[265] Incidentally, the latter reference discloses synthetic information highly relevant to the fabrication of the anthracene-like 1,8-diazaanthracene groups shown in Figures 47 and 48. More specific references include References 266 and 267.

The issue of how to connect the Figure 23 triboluminescent molecule has been excluded from discussion. In my estimation, it will require (at minimum) extensive trial and error computer simulation to identify just the right kind of "mounting bracket" needed to prevent unauthorized squirming around. When done successfully (see baseline conjecture of Figure 24 with "wiper"), the 12 kcal/mole bending barrier of the Figure 23 molecule is easily overcome and a flood of photons emerges from each merry-go-round. The wipers will engage the Stack A rings like playing cards in bicycle spokes. Remember that as light is emitted, the system will grow colder as heat is self-pumped away. As symbolized in the Figure 49 cartoon, a collection of such ratchets will behave

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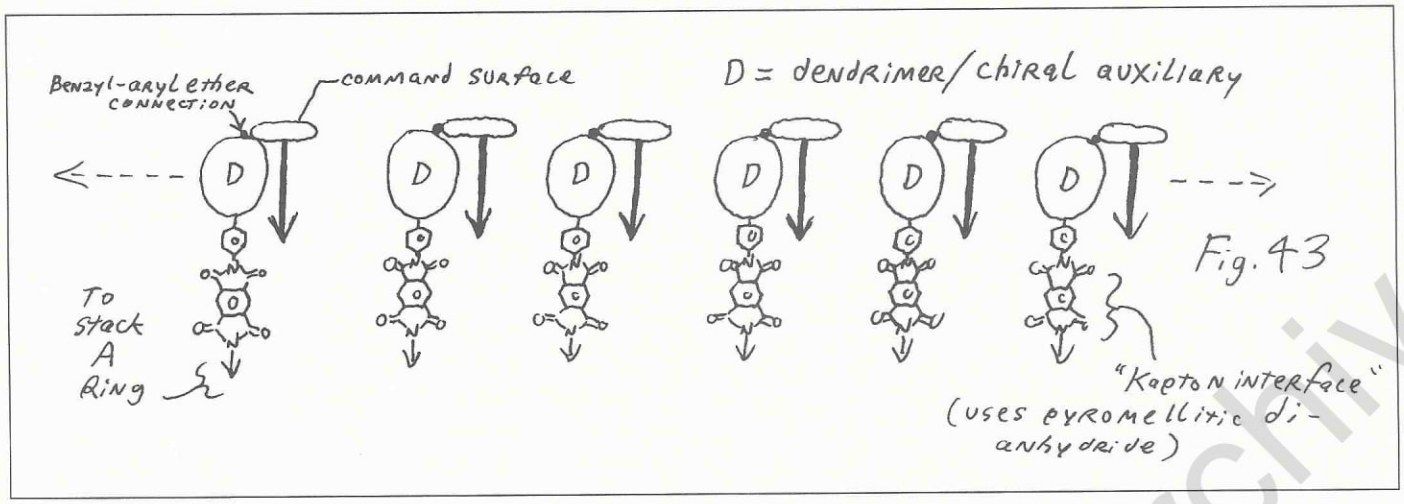

Fig. 43

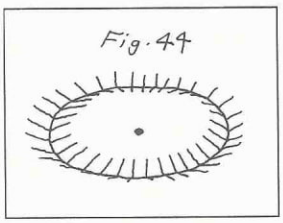

Fig. 44

both as an energy source and as a refrigerator.

It is possible that even after unlimited creative pressure is brought to bear on the problem, the synthetic cost of Figure 46 nanoratchets might prove too great to allow this anti-Second Law approach to compete with present-day energy sources. In such a case, it could still be of very strong interest to NASA since it will allow the facile recycling of heat in cost-is-no-object aerospace applications. This would be of especially good news to designers of "closed ecology" life support systems. Furthermore, spacecraft designers could eliminate thermal radiators that are required with conventional thermodynamic cycles. It is good to get rid of such things owing to their weight penalty and leakage potential.

Investigators of electrochemical cold fusion should also be strongly interested in any sort of closed thermodynamic cycle able to generate electricity. The glowing nanoratchets suggested in Figure 49 could be used to drive solar cells within the insulated confines of a calorimeter. As shown in Figure 50, this will provide the "gold standard" for experiments concerned with findings of "excess heat." For a peer-reviewed study that was published in 1989 that alleged that there is not excess heat, see Miskelly *et al.*,[268] but of course a huge body of technical papers opposes that conclusion (see http://lenr-canr.org).

There are those who would argue that the moment that the Figure 50 experiment becomes possible, it simultaneously becomes moot. Many will be persuaded that if you can *recycle heat*, you forever afterward have *true infinite energy*. Cold fusion is not needed, hot fusion certainly is no longer needed, and none of the "usual suspects" are needed either. Assuming the

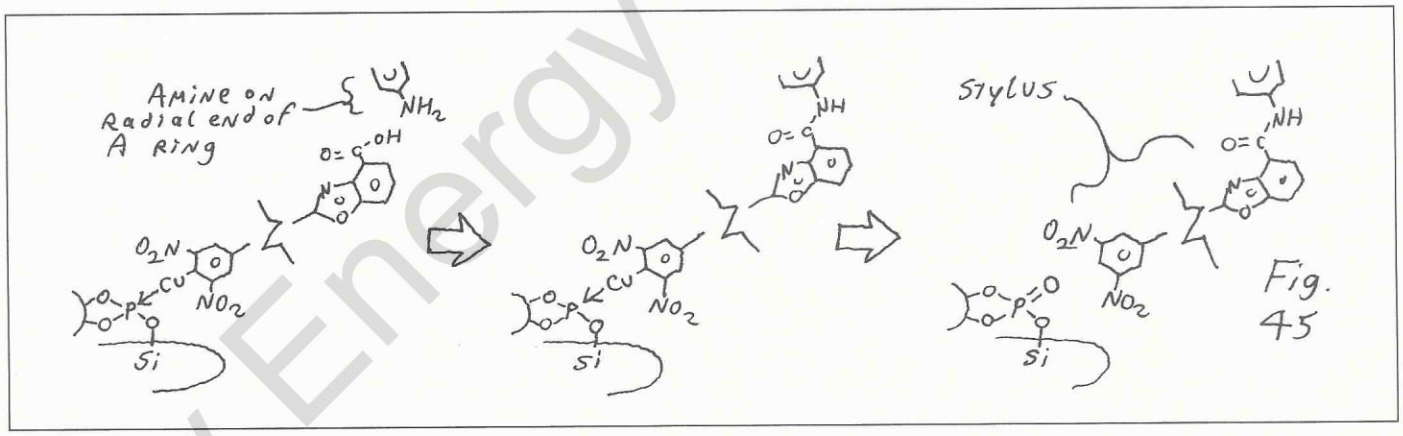

Fig. 45

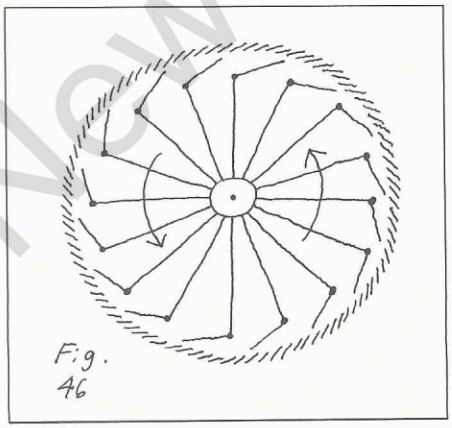

Fig. 46

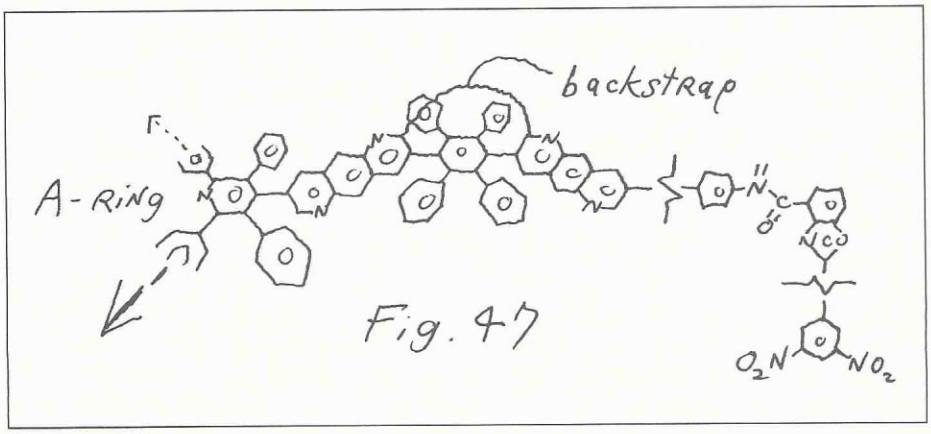

Fig. 47

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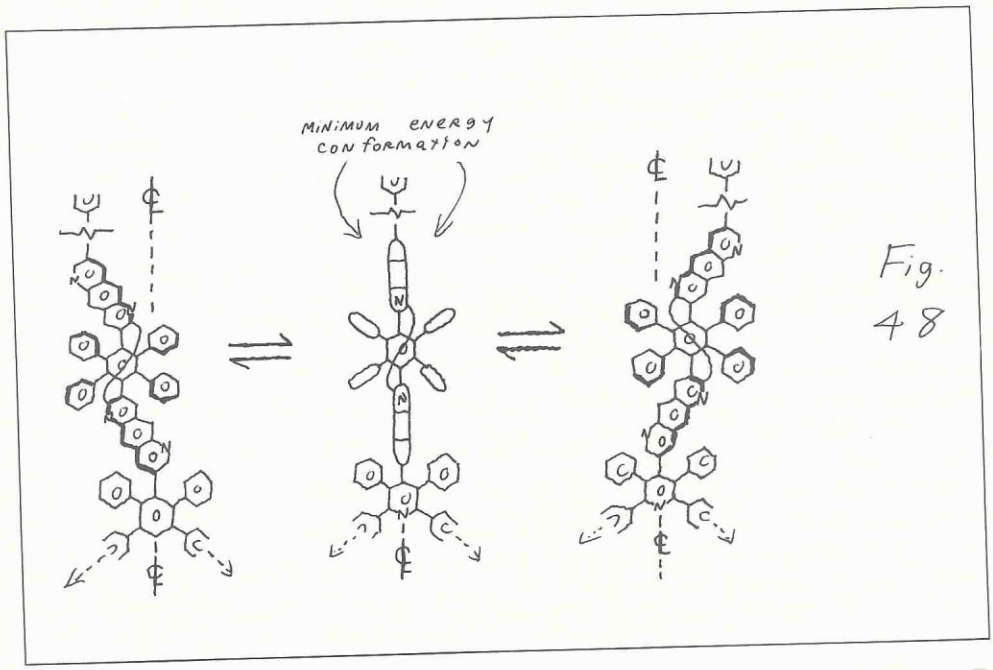

Fig. 48

cost is even part-way competitive, any number of other energy sources (windmills, solar collectors, fermented biomass, "clean coal," dirty coal, nuclear fission, tidal power, cats and dogs on treadmills, etc.) will also make a one-way trip to the scrap heap.

There might well be other methods for summing the outputs of trillions of disparate nanoratchets. Studies may show such methods to be superior to my suggestion concerning the utilization of triboluminescent molecules. Many of us who have lived more than a few decades often come to understand that there is always more than one pathway connecting "Point A" with "Point B." You can not only walk, but you can pedal a bicycle, ride a horse, drive a car, put yourself in a box and mail yourself, shoot yourself out of a cannon, etc.

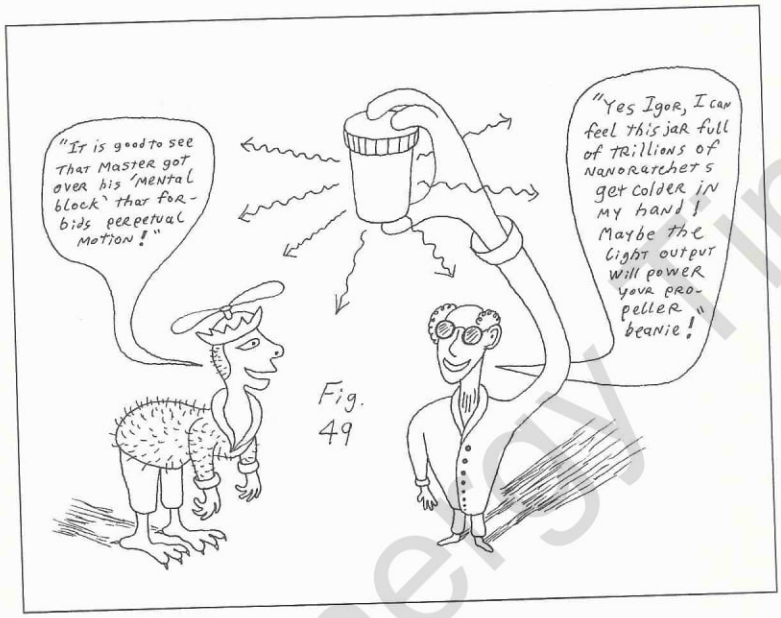

Fig. 49

Another route with respect to massively-parallel output summation could involve a "contact charging" effect that is known to be implicated in the operation of Xerox machines.[269] In principle, charge separation of any kind, even at a nanodimensional level, can be used to drive nano-size water-splitting electrochemical cells. In other words, if you play your techno-cards right, you could have a self-powered jar of nanoratchets in a water solution/suspension soaking up room temperature energy and putting out a mixture of hydrogen/oxygen! For those who would like to further investigate tribo-driven charge-separation, a U.S. patent assigned to A.M. Marks is an excellent starting point.[270]

Perhaps even more bizarre *yet possible in principle* is the *direct* production of "chemical gradients" through Brownian-rectified nanomechanics. The basic idea is actually not new. In 1994, Gordon published a paper[271]

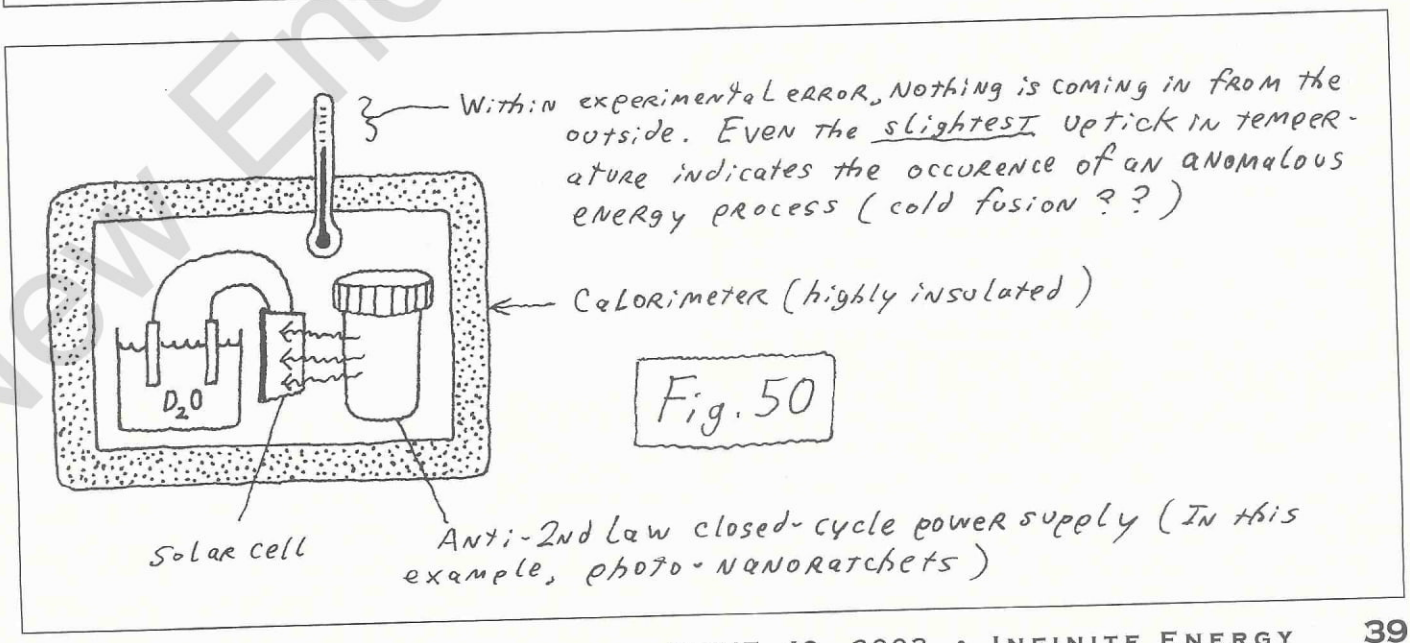

Fig. 50

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that claimed to describe a chemical gradient-producing machine driven only by thermal fluctuations.

A natural machine that is able to use osmotic gradients to form the energy molecule adenosine triphosphate has been shown already (see Figure 26 for ATPase). This fact was known clear back in the 1960s.[272,273] Obviously, reverse osmosis pressure can provide osmotic gradients. Of relevance here is that it was not proven until recent years that *mechanical rotation* is a central feature of the transductive powers of ATPase.

Based on peer-reviewed reports of "mechanocatalytic" water splitting,[274,275] we might permit ourselves the further conceptual leap of using Brownian-powered machines (in association with appropriate metal compounds) to *directly* decompose water. In other words, obtaining $H_2 + O_2$ without any sort of intermediate transformation, such as triboelectric charge separation followed by nanoelectrochemistry.

The 1999 paper by Ikeda *et al.*[276] states that when subject to agitation, a distilled water suspension of simple and mixed oxide powders (NiO, Co_3O_4, Cu_2O, Fe_3O_4, "$CuMO_2$" where M = AL, Fe, or Ga) decompose H_2O into hydrogen and oxygen. The typical conversion efficiency is claimed to be 4.3% (NiO oxide). The authors put forward a triboelectric mechanism to explain observations. However, it is admitted that such a model does not account for everything being seen. For example, it has become clear that the various metal oxides are (at least transiently) reduced to their base metals as one step in the process.

For a few general references on "mechanochemistry," see the 1994 review by Butyagin[277] and the shorter 1996 article by Gilman.[278] There are a few other references of potential interest to readers who want to investigate other studies on the use of metal oxides in thermochemical water splitting.[279-281]

I close this article by providing a quote from pioneering Second Law skeptic G.R. Primaves.[282] It came from a 1981 letter to the editor of *American Laboratory*, a little-known scientific journal. The quote proves that this writer is not the only one with radical notions concerning the future of Maxwell's Demon:

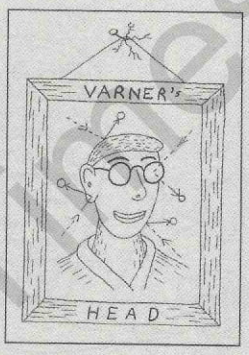
> My suggestion is that we do not need [an intelligent demon operating membrane trapdoors]. . .there is no question of energy barriers or energy required to open the flaps.
>
> We are now witnessing the enormously expensive and not necessarily finally successful research for a practical controlled-[hot] fusion power station. A "demon" membrane might be just as expensive, but would be much more amenable to ordinary use and, in my opinion, much more elegant and soul-satisfying. Using our brains to force chaos itself to produce order has an intellectual beauty that, to my mind, almost transcends any material gain that might ensue.

Epilog

We need to understand our roots. The Second Law began in the primitive 1800s as a rating system for the maximum possible efficiency of steam engines. This techno-fanatic writer personally has no problem with such a limited formulation. The style of thinking I find laughable is when other scientists came along and all too quickly hyper-extended Sadi Carnot's efficiency formula to say (in effect) that random motion *on a molecular scale* cannot ever, ever be harnessed. For the sake of completeness, let the record show that there is at least one thermodynamicist, Wayne Proell, who would dare to attack even Carnot's foundation.[283] Time will tell if Proell's proposition will bear fruit. Meanwhile, let the rest of us involved in "impossible causes" draw inspiration from the following fragment of Proell's wisdom:

> While there is still freedom,
> While there is still leisure, time, access, and money,
> While there are still colleagues who are trained to think
> The task of creating the impossible tools must be done
> When the night falls,
> It will be a thousand years before the chores of God
> can again be completed.

About the Author



A primary lesson that Kevin Varner learned during his school years in the 1960s is the value of self-motivated self-study, which is the main reason why he scored thirteen points above the 99th percentile on the eleventh grade Minnesota chemistry test in 1970. He has learned much more chemistry in the years since. Varner's official education ended with his graduation from Ogilvie High School in 1971. He explains, "I am not a 'math-type' person. I know full well that in order to get any kind of technical degree, you must embrace the 'cult of computation.' It so happens that equations can obscure things more than they illuminate. A very good example of this can be found with literature treatments of osmosis. The equation writers can take a perfectly simple thing like osmosis and turn it into a gummed-up train wreck! This could be the reason why a simple thing like tethered-solute osmosis evidently lay undiscovered for much too long." In addition to his chemistry observations, Varner has had a long-term interest in energy issues. His windmill experiments resulted in the publication of a seventy page book in 1979 and his solar energy experiments culminated in the issuance of U.S. patent 4488779 in 1984 ("Lightweight Heliostat System"). Varner sells his abstract drawings online at www.artcrawl.com.

*1757 Highway 47, Ogilvie, MN 56358

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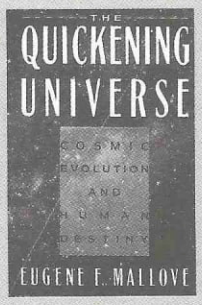

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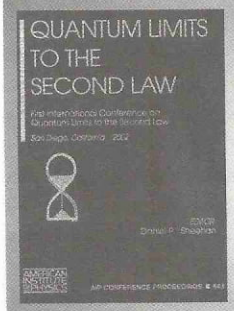

Quantum Limits to the Second Law:

First International Conference on Quantum Limits to the Second Law, San Diego, California, July 28-31, 2002

by Daniel P. Sheehan, ed.
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American Institute of Physics, Conference Proceedings #643, 2002

Review by Eugene F. Mallove

This magnificent landmark book might have escaped my attention had I not earlier learned of the group of physicists and mathematicians at the University of San Diego who published the startling paper, "A Solid-State Maxwell Demon," (*Foundations of Physics*, Vol. 32, pp. 1557-1595, October 2002, www.kluweronline.com). The paper by D.P. Sheehan and A.R. Putnam of the Physics Department and J.H. Wright of the Mathematics and Computer Science Department proposes a laboratory testable, solid-state Maxwell demon that uses the electric field energy of an open-gap p-n junction semiconductor device to drive a solid-state mechanical piston. In it they write, "It seems plausible that experimental tests of this solid state challenge to the second law may be on the horizon." (see *IE* #47, p. 35) The editor of the book in review, Prof. Daniel P. Sheehan, was the lead author on that paper. In this issue of *Infinite Energy* (see p. 17), we reprint another pioneering paper by Prof. Sheehan, "Four Paradoxes Involving the Second Law of Thermodynamics" (1998)—shocking but not *as* shocking as the Sheehan *et al.* 2002 *Foundations of Physics* paper.

The book at hand is a compendium of remarkably bold technical papers and analyses from the First International Conference on Quantum Limits to the Second Law, which was held in San Diego, July 28-31, 2002. This was attended by some 122 scientists from around the world (listed with affiliations in the book). The name of that conference itself was misleading (perhaps *deliberately* so), as is the title of this book, because the challenges it presents to the supposedly *macroscopically* inviolable Second Law range far beyond the papers in its leading section, "Quantum Perspectives." These occupy only the first 116 pages of this 507 page work in which 112 authors participate in 79 papers. That the American Institute of Physics (the sworn enemy of heretical physics) should agree to publish a book with content so devastating to its enterprise—almost *nothing* in modern physics, not even Special Relativity, is more sacrosanct than the infamous Second Law—can be explained only by the Trojan horse artifice of the word "Quantum" in the title. As we all know, stick "quantum" on almost any subject in physics (except cold fusion!), and the "craziness" that is being discussed is deemed kosher by the establishment.

What else is in the book? Chapter 2: "Classical Perspectives" (certainly no "quantum" there!); Chapter 3: "Experimental Tests and Proposals" (heaven forfend—actual macroscopic devices and macroscopic processes that stand (or potentially stand) the Second Law on its head); Chapter 4: "Motors, Rotors, Ratchets, and Engines" (more *actual devices and processes* that do/might violate the Second Law); Chapter 5: "Time and Gravity" (in essence, attempts to come to terms with the catastrophe that the Second Law has imposed on fundamental physical understanding, *i.e.* from time to gravity); Chapter 6: "History and Philosophy" (*i.e.* "How could we have been so stupid?!"); Chapter 7: "General Topics."

Naturally, the range of papers is uneven in what might be of interest to some technically inclined *Infinite Energy* readers, but this is a book that no serious technical person in the new energy field should avoid. I am thinking of people in the cold fusion/LENR field, in particular, and for those following the exciting hydrino science and technology work going on at BlackLight Power Corporation. Those who are dealing with heat-generating processes simply cannot afford to overlook processes that, in principle or practice, exceed Carnot-efficiency. Of course there will be a natural inherent fear of such information within the LENR/hydrino communities, because if Carnot efficiency can be exceeded, what follows instantly is that "perpetual motion machines of the second kind" (PMM2s) can be built. These are devices that can convert to work, at 100% efficiency, thermal energy from the environment—with only a single temperature reservoir being available.

How many of those who attended the conference on which this book is based think that PMM2s are possible? Editor Sheehan provides the answer in his preface: "Given the contention that has historically surrounded second law discussions, this conference was fortunate to maintain a collegial and constructive atmosphere. The balance and diversity of opinions was heartening. This balance is perhaps best demonstrated by the outcome of an informal vote conducted by S. Braunstein at the end of the last conference session. For belief in the following—'The second law is inviolable.'— the vote Yes: No; Maybe, and Abstain/Absent was roughly 25: 25: 25: 45. Although pains were taken to balance the conference slate, the evenness in this vote was surprising. Surely this was a select group, one not representative of the general scientific community. Were it so, we should properly consider ourselves in the midst of a fundamental paradigm shift involving the second law—which is clearly not the case." Then Sheehan, the clever chairman of the conference Organizing Committee, adds: "But, of course, all storms begin with a breeze."

Indeed, the long-awaited typhoon is probably coming.

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Compiled by Eugene Mallove

New Scientist Covers U.S. Navy Cold Fusion Report

Faithful readers of *Infinite Energy* have been aware of a two-volume technical report on cold fusion, which strongly supports the research, a document published last year under U.S. Navy auspices. This was Technical Report 1862, February 2002," Thermal and Nuclear Aspects of the Pd/D_2O System" (see *IE* #44). Now the U.K. publication *New Scientist* has chimed in with an article about this report.

The article in *New Scientist's* March 29, 2003 issue (pp. 36-43), written by New Hampshire-based journalist Bennett Daviss, pointedly discusses *only* the Navy report and no other research conducted by cold fusion scientists that has been published in other technical journals (or in *Infinite Energy*) or in the various Proceedings of the now nine International Cold Fusion Conferences. It does, however, mention the website www.lenr-canr.org, which enables readers to examine other downloadable technical articles on low-energy nuclear reactions.

For the much maligned science of cold fusion, *any* publicity is better than *no* publicity—even if the article in question is poorly done, negative, or neutral in its stance. This *New Scientist* piece by Ben Daviss is not negative and not poorly done *per se*, but it is most certainly deadly neutral—no doubt precisely what the *New Scientist* editors demanded of the writer if he were going to attempt a cold fusion piece at all. How else to explain the absurd title, "Reasonable Doubt," which could cut both ways. The cover of *New Scientist* promoted the article thus: "Cold Fusion: What the U.S. Navy found after ten years' research." In the Table of Contents, the Navy scientists' work is dubbed a "strange story." None of the more prominent cold fusion scientists (apart from Dr. Melvin Miles and Dr. Stan Szpak/Dr. Pamela Mosier-Boss) had their work reviewed or referenced for this article—not even cold fusion pioneer Dr. Martin Fleischmann, though he is a co-author of the Navy report. Presumably these scientists, though indistinguishable in their general outlook about cold fusion, were deemed less than reliable by *New Scientist*. In a book review of science sociologist Bart Simon's *Undead Science: Science Studies and the Afterlife of Cold Fusion* (2002) in the issue of *New Scientist* of the previous week (March 22), the *New Scientist* editors selected this slimy out-take line for prominence—the reviewer's vulgar comparison of cold fusion: "The result recalls the late Frank Zappa's quip about jazz: it's not dead, it just smells funny." With that as background odor, what else might one expect of the present article by Daviss? Thus, the most objectionable aspect of this feature by Daviss is that it presents a disconnected and distorted view of what is really going on in cold fusion. It conveys the highly erroneous impression that there is really no other research in the field that comes close to the high quality of this Navy-sponsored work, and that even this Navy research can be "reasonably doubted."

After stating up front that the Navy report presents evidence that cold fusion is real, the article's most offensive sentence is delivered, "If this claim were being made by almost anyone else, it probably would—and maybe should—be greeted with embarrassed silence." What?! Blanket condemnation of all other cold fusion publication venues and conference Proceedings? This pre-supposes a scientific knowledge and sophistication that the editors of *New Scientist* most certainly do not possess on the subject of cold fusion/LENR. But this obnoxious bit of bigotry is just the fig-leaf cover for *New Scientist's* abandonment of intelligent coverage of cold fusion for the past dozen years—about what one would expect from its editors past and present. There has been essentially *no* coverage of cold fusion during the past dozen years in *New Scientist*, mixed in with—from time to time—egregious *mis*information about it (see below). This, from a popularized science magazine that specializes in splashy cover stories with the trashiest speculative nonsense about quirky new interpretations of quantum mechanics, supposed "dark energy," multi-universes, and other irrationalities sanctioned by mainstream physics. Such hot air is allowed about anything and everything within physics, but not about replicable table-top experiments demonstrating low-energy nuclear reactions, which suggest profound new physics at work—way beyond the ken of the *New Scientist* editors and its mainstream Fizzix fictionalizers. It will be delicious to observe how these editors will dig themselves out of their deep hole some years hence, when, we trust, they will be forced to do so.

Daviss has authored at least one other article on cold fusion—a profile of this editor in TWA's in-flight magazine, an article reprinted with his permission in *Infinite Energy* (see #17). He has also written other pieces on alternative energy for *Infinite Energy*, for which we have been grateful. Daviss is honest, open-minded, a hard worker and a gentleman. On his own initiative last year, but with my encouragement and advice, Ben undertook his difficult process of getting *New Scientist* to write an update about cold fusion, and we are glad that he succeeded—whatever restrictions were placed on his coverage, willingly or unwillingly accepted by him.

Though I have not yet seen any earlier draft version of the article, as some Navy cold fusion scientists have, I do know that the article was originally much longer (some 8,000 words)—perhaps about twice as long as the published version. No doubt a longer feature would have given more range for positive discussion. It should be mentioned that there are some serious omissions and loose ends in the article as it stands:

- There is no mention of the critical fact that Dr. Melvin Miles tried—in vain—to persuade the DOE anti-cold fusion panel in 1989 to include his later positive excess heat results, which were obtained in ample time to be inserted in the Huizenga panel report. He was rebuffed and only his earlier negative results were included.
- In discussing the helium correlation with excess heat

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obtained by Dr. Miles, it is not mentioned that these results were announced as early as 1991, and—more important—that Miles calculated the probability that his helium-producing cells could randomly match the excess-heat-producing cells in the group of cells tested for helium and excess heat. The chance was only 1 out of 16,384, that is, 0.0061%!

• In discussing Dr. Michael Melich's retrospective look at some of the allegedly negative results for excess heat, Daviss writes: "MIT officials told Melich that they had thrown away all the data and notebooks, and had nothing for him to review." This statement by the "MIT officials" (whenever it occurred) may or may not be true, but the editors and author should know that original data was, in fact, examined extensively by both this author (Mallove) and another MIT graduate, Dr. Mitchell Swartz, and found to show: A) Significant evidence for excess heat in the MIT calorimetry experiment and B) Proof of *fraudulent* manipulation of the heavy water excess heat results to suppress the finding of excess heat. Ben Daviss, of course, knew about these facts. They should either have appeared in the article, or the remark about Melich and the alleged disappearing MIT notebooks should not have been made. Let us keep the key facts of science history straight.

In thinking about how *New Scientist* has treated cold fusion over the past dozen years, I am reminded of an appalling breach that occurred in its May 1, 1993 issue, which our late editorial colleague Christopher P. Tinsley of Nottingham, England commented upon in a letter sent to it on May 2, 1993. This letter was never published by *New Scientist*, or even acknowledged. For the benefit of history, and to further prove what the editors of *New Scientist* have really been about on the matter of cold fusion, it is our pleasure to reprint Tinsley's letter. Chris would be pleased to know that it appeared "from the grave" (actually, from the dusty urn) years after his 1997 death:

May 2, 1993
Dear Sir,

You express your concern (Comment, 1 May) that science should be accurately reported.

Turning to page 6 of the same issue, I saw with interest your article on the latest cold fusion paper from Profs. Fleischmann and Pons, which I was able to compare with the actual paper (*Physics Letters A*, Vol. 176, 1-12, 3 May 1993). This comparison showed a level of distortion and inaccuracy which astonished me.

Your article refers to excess energy of up to 2W/cm^3. The paper refers to excess energy which "remains relatively constant at about 20 watts/cm^3 for the bulk of the experiment, followed by a rapid rise to about 4kW/cm^3 as the cell boils dry." Further, even after the cell has boiled dry, it remains at a temperature of about 100°C for some hours.

The article shows a diagram based on a graph from the paper. This shows an aspect of the calorimetry during the first few hours of the experiment. The calorimetry of the boiling phase, which occurs some days later is shown in the paper in an adjoining graph, which you omit. This graph shows the sudden increase in excess energy per unit volume which accompanies the start of the boiling phase. The comments from Dr Williams [Ed. Note: of the U.K. Harwell laboratory] on 'small discrepancies in the measured temperature' and, "It is very sensitive to experimental error," seem to me quite ludicrous in this context.

Having seen his quoted remarks in the French newspaper *L'Express*, I am driven to doubt whether Professor Vigier would consider your report of his actions to be fair or in context. As to the question of whether the excess energy has a nuclear origin, it should be noted that the paper—as its title clearly states—is concerned solely with the calorimetric aspects of the work. However, a simple calculation based on the information in the paper shows that in the boiling phase alone, the excess energy is several hundred eV/atom of Pd, which is two orders of magnitude greater than any possible chemical reaction.

These comments are far from exhaustive. Should you not decide to follow this remarkable travesty of science reporting with a full and accurate article on the subject then it will at least be a matter of record that you are happy to let it stand.

Yours faithfully,
Christopher P. Tinsley

Alleged Free Energy Device Stumbles

A postscript to our "Eclectic Observer" item in *IE* #48, "New Free Energy Device Claim Made." We received the following memorandum from Dr. Steven Greer, which will be a great disappointment to those who had hoped that his January announcement would come to fruition:

Memo: To all SEAS Investors, Consultants, and Interested Members of the Media and Public
From: Steven M. Greer MD, CEO SEAS
Re: Update on SEAS technology acquisitions

As all of you know, SEAS identified a promising over unity technology in January of this year, and subsequently negotiated an agreement to acquire the technology. Since then, previously undisclosed business interests of the inventor have surfaced and have stopped the acquisition process. For this reason, to date we have not been able to acquire the device for further testing or reproduce its performance. We have been negotiating for six weeks to resolve the issues raised by these other interests, a process that has involved parties in three countries.

At this point we do not know if or when the inventor will fulfill his obligations to SEAS under the original agreement. We will let you know as soon as the technology has been submitted to us for further development and verification and the results of that process are known.

In the meanwhile, we have identified several other very promising systems, one that is generating 35KW over unity, according to the inventor. Another is a solid-state system that shows significant promise, as it would have no moving parts. The entire SEAS team is very engaged in investigating, testing and acquiring these technologies. You will be informed just as soon as confirmed tests and reproducibility studies are completed on any of these new energy systems.

Thank you for your continuing support and interest.

Russian Newspaper *Pravda* Notes "Perpetual Energy Source"

This article, which we quote below in full, appeared on the English-language website of Russia's *Pravda*, April 15, 2003—http://english.pravda.ru. We can make no judgements about the truth of the claims, with such limited information—which is flimsy indeed. It is interesting, however, that a new scientif-

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ic controversy about a new energy claim was treated skeptically, yet given some space in a high-profile publication in Russia—the former mouthpiece of the Communist Party of the Soviet Union:

Alleged Creation of Perpetual Energy Source Splits Scientific Community

On the one hand, it may be an incredible breakthrough that will help realize the ideas of science-fiction writers. On the other, many say the creators are mistaken.

The Russian Academy of Sciences is treating the news that Volgograd University laboratories say they have discovered a fundamentally new source of energy rather skeptically. A special meeting with journalists dedicated to the discovery was later held in Moscow, in which the results of the scientific experiment were presented. One of the items presented was a chemical compound that, according to scientific laws as currently known, cannot exist in nature.

Academician Valery Sobolev from the Academy of Sciences, the head of the research group working on the experiment, says that "This is not some new physics, but just experiments that have been performed with great seriousness. Create a surge of electrons in the environment, remove them, deplete the fused electrolyte with base-type metals, and what you derive cannot be produced by chemical methods. This is a new form of substance."

According to the researchers, first, they discovered a particular electrochemical process the product of which is high-temperature materials in a new state. This, in turn, allowed for the discovery of a new state of substance, a new class of materials, a new source of energy, a new method of cold-plasma generation and a new superconductor.

As soon as the team headed by Sobolev reported on possible uses for the discovery, Prof. Kapitsa, a Corresponding Member of the Russian Academy of Sciences, spoke on the problem. He did not discuss the dubiousness of the discovery. Indeed, he was extremely surprised that the researchers were trying to prove the scientific character of the discovery in non-specialty publications in which "naive journalists sometimes don't understand what the scientists are telling them." Also, Kapitsa says that the group headed by Sobolev encroached upon the fundamentals of physics that cannot be spoken of in passing.

The professor added that some researchers had already brought six licenses for perpetual motion machines to him and that they had taken out patents for their inventions. He said it is very strange that Sobolev's group did not mention the discovery in any specialized scientific magazine.

Another scientist, Academician Valery Lubakov, voiced harsher criticism regarding the invention. He is of the opinion that it has no connection with science, and that the use of the press for unscientific and false purposes is unethical.

However, the speakers from the Russian Academy of Sciences are probably forgetting about the YUSMAR systems that first appeared in the Moldovan city of Chisinau. This technology has been patented in 42 countries. The YUSMAR system was tested several times in reliable research centers in Russia and the United States. It was discovered that the system produced about two kilowatts of heat per one kilowatt of consumed energy. This technology caused much dispute. Is it a perpetual-motion machine? Many scientists are convinced that this machine cannot operate, but it does.

Let's leave it for scientists to decide whether the machine can work or not. In the near future, the fantastic invention of the Volgograd research group will be realized. A Canadian company has already concluded a contract with Volgograd's Scientific industrial center GRUS for production of a new type of power source. The company believes that this new technology can "change the whole energy-supply system."

These compact generators can continuously generate electricity and need no technical input: Their duration is unlimited. Thus, people having the appliance will obtain an electric-power station of their own that can be placed in the home or office. The power capacity of the new generator is three to ten kilowatts, which is quite enough for energy supply to an apartment or an office. ❑❑❑

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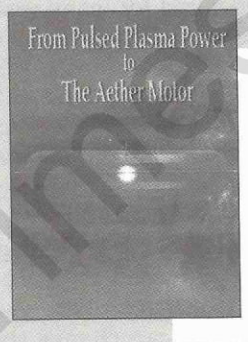

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The Emergence of Magnetic Technology in Industry in Canada

Leo Delaney*

The use of magnetic technology in industrial and commercial buildings has been recognized for many years in Russia, Japan, and China. They recognized the value of magnetic power in water treatment that substantially reduced or eliminated the need for chemicals. The U.S. Department of Energy[1] has made strong recommendations for the use of magnetics as a non-chemical technology in the prevention and removal of scale and hardness control to improve energy efficiency.

However, scientists discovered that the effect of magnetic fields are not limited to water only and all of the materials experience magnetic fields to different extremes. According to the studies, magnetic fields can change the electron's spin orientation, which may enhance the reactivity of the atom and related molecules. The new science had led different organizations toward using magnets in other energy-related applications.

In China, extensive testing has been completed on the railway system in diesel engines, with considerably favorable results.[2] The Chinese have also made strong initiatives towards the reduction of surface tension in hard water without the use of chemicals.

NASA, for example, tried to use magnetic technology to improve the combustion of liquid hydrogen in order to decrease the fuel weight in the space shuttle. The conversion of hydrogen from stable "Para-hydrogen" to more reactive "Ortho-hydrogen" through the use of magnetic fields was discovered by Ruskin and described in his U.S. Patent #3228868.

As a result of almost a decade of research and development, magnetic devices are presented to the commercial and industrial world in order to reduce fuel consumption and emissions. Today the advanced non-intrusive permanent magnets can effectively increase the number of BTUs produced per cubic meter of any hydrocarbon-based combustible fluids, such as natural gas, gasoline, propane, and diesel fuel.

Avoca-Tec has been using this technology for the past five years in residential and commercial fields and has had many successful applications of this technology across Canada. Our non-intrusive magnetic technology also can be used in various industrial applications, such as boilers, dryers, unit heaters, furnaces, kilns, gas and diesel engines, cooling towers, and condensers.

Recent Development in Canada

In 2000, the International Nickel Company (INCO) in cooperation with Avoca-Tec of Montreal decided to study this effect on two different applications: a) reduction of diesel emissions to improve air quality in the working area of the mine, and b) reduction in the amount of energy consumed by air conditioning and heating systems in heater houses.

The first test involved the impact of magnetic technology on diesel engine performance in order to study the possible reductions of emissions, total hydrocarbons (THC), and diesel particulate matter (DPM), plus the effects on exhaust quality index (EQI).

Tests were performed on a brand new diesel engine, Detroit diesel DDEC Series 60, 11, 1, L Mine with engine rated at 325 HP @ 2100 RPM at Canmet, Mining & Mineral Science Laboratories, Bells Corner, Ottawa, Ontario, Canada (government research lab).

The results showed that on this new engine the THC and the DPM were reduced by 21% and 11% respectively, and the effect on EQI was reduced by 3%. Test data is available upon request.[3]

It was felt that these results were significant but that a different experiment needed to be done on a larger scale, so for the second stage of the test a heater house for winter heating of mine ventilation air was selected.

The results of magnetizing the natural gas headers in the heater house were substantial and a savings of 11.95% was achieved. *See the following paper by Dr. Greg Baiden for details.*

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Magnetic Technology Applied to Mine Ventilation Systems Achieves Results Through LHDs and Heating Systems

Greg Baiden

Mine ventilation systems provide air to underground mines through large fan systems and a series of raises and tunnels. Doors and barricades are put in to direct the flow of fresh air to the places it is needed in a mine. At present, the solution to meeting TLV's limits has been to increase the volume of air entering the mine to dilute it appropriately. As the pressure to improve the underground environment has been mounting, the idea of magnetizing fuels for providing more complete combustion has been a potential solution that needed a fresh look. Demystifying magnetization and how it works to provide more complete combustion has been the major stumbling block to understanding the value of this idea. This paper describes two experiments that were done over the last two years to improve our understanding of how magnetization can make a potential difference.

The first experiment involved testing a diesel engine in a controlled environment without and with magnets. The results, while not totally conclusive, did indicate something significant was happening. Due to these results a different experiment needed to be done on a larger scale. It was decided that a larger quantity of fuel being combusted continuously would speed getting results. Therefore, a heater house used for winter heating of mine ventilation air was selected. The results of magnetizing natural gas headers in a heater house were substantial. Over a two-year test period, a total of 11.95% less gas was used to heat the mine air.

This paper will provide background for the reader into fuel magnetization theory, the initial diesel combustion experiment, the McCreedy East mine experience, and then discuss the potential of this exciting new technology and future work that will be undertaken.

Introduction

Ventilation of a mine is one of the most important functions that allow miners to go to work everyday. Over the years, miners have always been concerned about the quality of the air they breathe. Early miners carried canaries with them and observed the birds, ensuring they were still alive. If the canary was dead the miner needed to leave the area immediately, as the air was unsafe. Today, mine ventilation systems are quite sophisticated, millions of CFMs of air are blown into the mine through fan systems and mine ventilation specialists monitor that air for quality so that the miners running today's diesel equipment will be safe. Even with this approach, concerns are being raised about the potential impact of diesel emissions on the health and safety of miners.

Avoca-Tec, in conjunction with INCO, undertook an innovative approach to achieving more complete combustion on diesel engines used underground. It was projected that two benefits might potentially occur. The first was cleaner air leaving the diesel engine exhaust and the second was reduced fuel consumption. With these goals in mind a test program was devised. A controlled environment was created to understand if these results were possible. The results of the first experiment, while indicating a significant shift in air quality and fuel consumption, did not prove totally conclusive. Therefore a second experiment was devised using an increased volume of combustible fuel in a heater house that heats mine ventilation air in the winter. A one-year period of monitoring was done on the heater house without magnets and the second year the magnets were installed on the headers of the heater house. This installation was monitored and after two years the results were completed in May 2002. The savings in natural gas as a result of the installation of magnets was 11.95% in 2001-2002 when compared to 2000-2001.

This paper outlines magnetic technology, the diesel engine experiment, the heater house experiment, and discusses the results and outlines future work that will be undertaken at Laurentian University.

Theory of Magnetism

In 1989 the Nobel Prize in Physics was awarded to Hans Dehmelt of the University of Washington in Seattle for his work on the fundamental properties of electrons. The Nobel Prize was a result of forty years of research into the basic properties of the electrons.

The electron has only four known characteristics: mass, charge, spin, and magnetism. And over the preceding years, mass and charge had already been measured to high levels of accuracy, but the electron's spin and magnetism were another story. The spinning analogy leads us to the electron's magnetism. For example, if an unmagnetized iron rod is placed into rotation about its cylindrical axis (turned like an axle rather than lengthwise as a fan), the rod will become magnetized. This is known as

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the Barnett effect. Also, an electron by virtue of its mass, charge, and spin is also a magnet. If electrons are provided with the precise amount of magnetic energy, the spinning electron will absorb that energy and flip into alignment. The exact amount of energy required to produce a "spin flip" is determined by the g-factor, known as the gyromagnetic ratio, discovered by Paul Dirac in 1928. Dirac noticed in his experiment whole atoms absorbing and releasing energy as the electrons undergo spin flips.

We should bear in mind that all materials experience magnetic effects. It is merely a question of degree of influence. All the known elements in the periodic chart fall into two categories—paramagnetic or diamagnetic. With paramagnetic materials, the flux draws the materials into the areas of stronger flux. Ferromagnetics are a special subclass of paramagnetics, since its (iron/magnet) attraction is extraordinarily strong. What we see on a daily basis is ferromagnetic interaction. Just because we don't see strong attractive forces with other materials doesn't mean that there is no effect. In many cases the term non-magnetic actually means non-ferromagnetic. Diamagnetic materials, on the other hand, are materials that are driven into the weaker areas of magnetic flux.

Most materials possess paired electrons. However, some materials, for example iron, have unpaired electrons. It is the action of spin of the unpaired electron that gives rise to the effect we call magnetism. It is simply the unpaired electron spin of the electron that gives rise to its magnetic moments and related field. As an example, hydrogen in its para or ortho spin form can either be paramagnetic or diamagnetic depending on the spin orientation. Orthohydrogen with its coincident spins is far more unstable than its para counterpart where the electron/nuclear spins are in opposition. Hydrogen in its para form can be converted to its ortho form by the application of an appropriate magnetic field.[1] This process makes the hydrogen more volatile or more combustible.

Fuel Treatment by Magnetic Technology

Hydrogen is the lightest and most basic element known to man. With its simple structure comprised of only one proton and one electron, it is one of the major constituents of all hydrocarbon-based fuels. It possesses two distinctive forms: ortho-hydrogen and para-hydrogen. In para molecules, the spins of the protons are anti-parallel, while in the ortho molecule the spins are parallel. The para molecules occupy the even rotational levels, and the ortho molecules occupy the odd levels. The orientation of the spins has a pronounced effect on the behavior of the molecule. In fact, ortho-hydrogen is unstable and more reactive than its para-hydrogen counterpart. The liquid hydrogen fuel that is used to power the space shuttle is stored on the para-hydrogen form, which is less volatile.

The magnetic treatment of fuel represents a new technology. The Magnetizer Group Inc. is responsible for founding the monopole technology, or in simple terms, the use of the single pole technique. This monopole application is why all prior systems to the Magnetizer could not show sufficient results. Consequently, the reactivity of the atom and related molecules are enhanced. The make up of natural gas is 78.8% methane. In methane (CH_4) the carbon content of the molecule is 66.6% while the hydrogen content is 33.3%. When the carbon portion of the molecule is combusted it will generate approximately 14,000 BTU per pound of carbon. On the other hand, the hydrogen which comprises only 33.3% of the molecular weight will generate an amazing 61,000 BTU of heat per pound of hydrogen. Thus we can see the importance of hydrogen in generating heat when a hydrocarbon molecule is burned. By altering the spin properties of the electron, we can enhance the reactivity of the fuel and related combustion process.

Diesel Engine Experiment

In 2000, Avoca-Tec proposed to INCO the testing of magnets on diesel engines to achieve a reduction in fuel consumed and potentially a reduction in diesel emissions. The projection was a 3 to 4% savings in fuel. While magnet technology had been proposed to INCO before, it was decided to give the technology a fresh look in light of the new technology developed by Magnetizer.

An LHD at the research mine was selected. It quickly became apparent that this testing procedure would need to change as a much more controlled environment would be needed to verify the results. In the fall of 2000, a decision was made to ship a brand new DDEC Series 60 11.1L electronically controlled diesel engine to the CANMET Diesel Engine Testing Lab at Bell's Corners in Ottawa.

The engine was first run without Magnetizer magnets attached to get a base line. For the next phase of the test "Magnetizers" were installed on the intake fuel line, intake air, intake and return coolant lines. The bench testing was conducted at all the 8-mode operating points as described in the MAPTEST report.[2] The 8-mode test cycle is specified by the International Organization for Standardization (ISO) as ISO 8178-4, cycle C1, for "Off-road vehicles, diesel-powered off-road industrial equipment."

Steady-state measurements for engine parameters and exhaust emissions were made before and after the application of Magnetizer's magnet product on the engine. The measurements for engine parameters included speed, torque, fuel consumption, intake air mass flow rate, and exhaust temperatures. The exhaust emission measurements included CO, CO_2, NO, NO_x, Total Hydrocarbons (THC), and diesel particulate matter (DPM). The SO_2 and Exhaust Quality Index (EQI) were calculated. During the engine testing a low sulphur fuel with sulphur content of 0.036% by weight was used.

The results achieved are shown in Table 1. As can be seen in the table, some significant changes occurred during the engine testing. There were increases of 17% in CO and 8.8% in NO_2. At the same time, a number of the measured parameters showed decreases. Very significant changes occurred in total hydrocarbon production (-20.6%) and diesel particulate matter (-10.7%). Since the conclusions from the test were questionable, Avoca-Tec was consulted. Upon consultation it was determined that the break-in period was too short and a more suitable break-in period would be two to four weeks. It can be seen though that something is happening to the combustion process of the engine. Therefore, further investigation was warranted. At this point, a different controlled test was needed with higher consumption of hydrocarbon fuel and the appropriate controls to measure the inputs and outputs to the system. After careful review, a heater house was chosen.

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	Without Magnetizer	With Magnetizer	Magnetizer Effectiveness
Speed, rpm	1623	1623	Nil
Torque, ft.lb.	532	532	Nil
Power, hp	174	174	Nil
Fuel rate, lb/hr	61.9	61.9	Nil
CO, gr/hr	58	68	- 17.2 %
CO_2, gr/hr	80378	79253	1.4 %
NO, gr/hr	447	434	2.9 %
NO_2, gr/hr	34	37	- 8.8 %
NOx, gr/hr	481	471	2.1 %
THC, gr/hr	34	27	20.6 %
DPM, gr/hr	8.4	7.5	10.7 %
EQI	55.6	53.7	3.4 %

Table 1. Diesel engine measurements without and with magnets on the fuel line.

Period						Gas Consumption Total (M3)	Number of Days	Degree Days (DD)
From			To					
Y	M	D	Y	M	D			
2000	Dec	20	2000	Dec	31	173,184.0	11	344
2001	Jan	1	2001	Jan	31	390,024.0	30	884
2001	Feb	1	2001	Feb	28	382,314.0	28	828
2001	March	1	2001	March	31	247,332.0	31	706
2001	April	1	2001	April	30	16,939.0	30	390
Total						1,209,793.0	130	3,151
Average Gas Consumption without Magnets: 383.93 M3/DD								

Period						Gas Consumption Total (M3)	Number of Days	Degree Days (DD)
From			To					
Y	M	D	Y	M	D			
2001	Dec	20	2001	Dec	31	52,289.0	11	272
2002	Jan	1	2002	Jan	31	320,448.0	30	805
2002	Feb	1	2002	Feb	28	319,258.0	28	775
2002	March	1	2002	March	31	293,279.0	31	790
2002	April	1	2002	April	30	60,621.0	30	451
Total						1,045,895.0	130	3,094
Average Gas Consumption with Magnets: 338.04 M3/DD								

Table 2. Normalized heater house gas consumption data.

Heater House Application

Mines in northern climates require the heating of air to create a workable underground environment. Typically the air is heated today using a heater house (Photo 1) installed on surface in series with ventilation fans to blow the air into the mine. Many approaches have been tried to minimize consumption. Typically, these have included turning off natural gas when not in use and sophisticated monitoring and control systems. To date little work has been done in preparing the fuel for more complete combustion.

The first step in this experiment was to monitor gas consumption. INCO's McCreedy East Mine was approached as a test site due to the fact that gas consumption was monitored. This made this the ideal place for a test. Information from the 2000-2001 heating season was collected for later analysis. With this information in place magnets from Avoca-Tec were obtained and installed in the summer of 2001. This installation is shown in Photo 2. With the magnets in place, the monthly data for the 2001-2002 heating season was collected.

Collection of natural gas consumption between two heating seasons needed a method of normalizing the data. Year 2001-2002 data was collected and normalized using degree-days methodology. Degree-days normalize temperature data between multi-years. Typically, government meteorological stations collect the temperatures. This normalized temperature data was collected at the Sudbury Airport and applied to mine heater house data on natural gas consumption.

Table 2 shows the data for the two heating seasons. As can be seen in the table, the 2000-2001 heating season used an average of 383.93 cubic meters per degree day without magnets. Once the magnets were installed in the next season, the average consumption for the 2001-2002 heating season was 338 cubic meters per degree day. This change from the 2000-2001 to 2001-2002 season was the result of installing magnets on the heater. Careful care was taken to ensure no other changes took place in the two seasons. Given these results, the change amounted to an 11.95% reduction in natural gas for the same mine once normalized. This result is extremely impressive through only the addition of magnets to natural gas headers in a heater house.

Summary

Magnets were installed on both a diesel engine and the headers of a heater house at INCO. The magnets yielded very interesting positive results. While the test was incon-

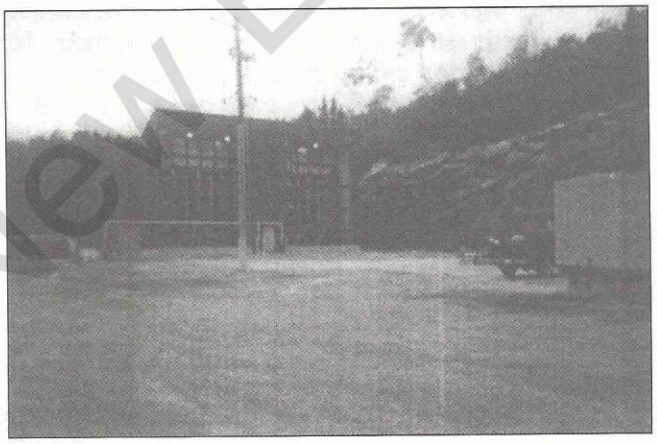

Photo 1. Typical mine heater house.

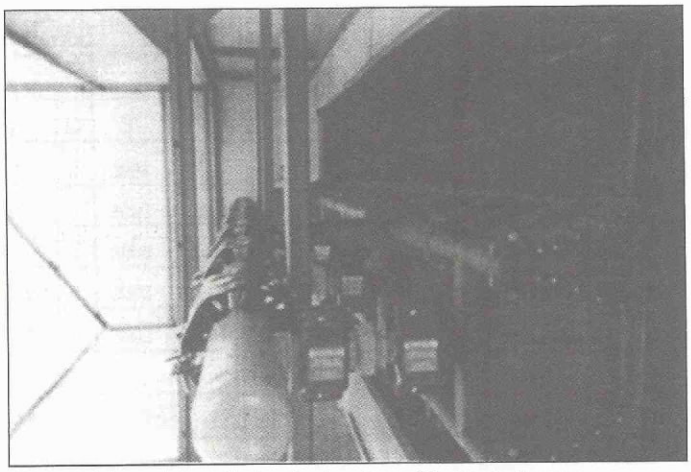

Photo 2. Magnets installed on the headers of the heater house.

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clusive for the diesel engine, it yielded results that require further investigation.

The second part of the experiment used a monitored heater house. This experiment was conducted over a two-year period. This experiment showed very impressive results reducing natural gas consumption by 11.95% once adjusted for degree days to normalize the information.

Future Work

Given the results achieved on the INCO McCreedy East heater house a decision has been made to install more magnets in the McCreedy East complex. The results outlined in this paper will continue to be tracked for the 2002-2003 and 2003-2004 seasons to get more data on the applications of magnets to more complete combustion in mine heater houses.

With the positive results achieved in the heater house experiment, the diesel engine results will now be reinvestigated. Avoca-Tec will install magnets on one of a fleet of two LHDs at McCreedy East Mine. The first machine without magnets will be used as a baseline to measure the improvements with magnets installed. INCO will supply emission results for two LHDs in the mine over a one-year period to determine the outcomes of this work.

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About the Author

Dr. Baiden is the chairman and chief technology officer for Penguin Automated Systems Inc. He was employed by INCO Limited from 1988 to 2001. He has a B.Sc. and M.Sc. in Mining Engineering from Queens University (Kingston, Ontario, Canada) and a Ph.D. in Mining Engineering from McGill University (Montreal, Quebec, Canada).

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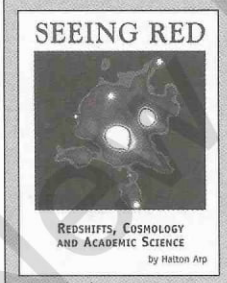

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Space Power Generator and Paramahamsa Tewari Update

A new generation of space power generators is being built by Paramahamsa Tewari. The new design is expected to achieve substantial gains over previous models that have measured over-unity by experts in the utility industry as well as by independent consultants. Details are presented on Tewari's website, www.tewari.org.

From the Electron to a Perpetual System of Motion

by Paramahamsa Tewari

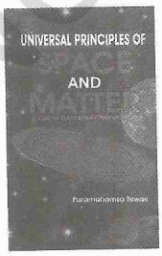
As is well known, an electron, despite high-speed interactions with electric and magnetic fields and other particles of matter, remains unaffected *structurally*—maintaining its mass, charge, inertia, and locality after the interactions. This single fact itself is sufficient to postulate on the existence of some unique universal entity constituting the electron, such that the structure explains the known properties and behavior of the electron—as to how it sustains the collisions with the other particles and, yet, remains permanently indestructible without any reduction in the quantities of its basic properties. A theory that explains this enigmatic fact is framed and described in detail elsewhere. It reveals that the electron is a *perpetually* rotating system, a space-vortex (vortex of absolute vacuum) that through the process of motion in electric current, and interaction with external magnetic field can also lead to the development of a system partially violating Lenz's law and, thereby, capable of achieving perpetual motion in a machine. Such a conclusion has a new theoretical basis, as well as experimental confirmation—briefly outlined in this paper.

The basic understanding of the interaction of electric current with magnetic fields requires deeper knowledge of the *fundamental* nature of the electric current as well as the magnetic field; this, in turn, leads to an inquiry on the nature of "electric charge" and its distribution in the electron structure. The origin of electron mass and charge, electrostatic and electrodynamic forces are described with the vortex structure of electron, which further facilitates explanation of atomic structure and, thereafter, an over-unity efficiency generator. Due to brevity, predominantly qualitative descriptions of the physical processes involved have been presented.

The full theory and diagrams are presented in "From the Electron to a Perpetual System of Motion" at www.tewari.org.

Universal Principles of Space and Matter

A new book (2002), *Universal Principles of Space and Matter*, has just been published by Paramahamsa Tewari. Arrangements are being made with the publisher to distribute this book outside of India. The price is expected to be about $30, depending on shipping costs from India.



The book proposes a new theory of matter that disagrees with the existing concepts of space in the contemporary physics. The basic phenomena dealt with are: structural interrelationship between space and matter; origin of mass, inertia, and electric charge; creation of the electron from space; discovery of new fundamental equations on mass and charge; derivation of the presently known universal constants (gravitational, Coulomb's constant, dielectric, magnetic permeability, electron charge, electron mass, Planck's constant etc.) with the postulate of a single universal constant—the speed of light in the absolute vacuum; discovery of an inward force in nuclear structure against the Coulomb repulsive forces, hitherto unknown; relationship between light and gravity; theoretical derivation of the surface gravity of the Earth, Sun, and the planets; discovery of electrical repulsive forces between the Sun and the planets, unknown in celestial mechanics; derivation of the planetary orbits; prediction of the continuous creation of universal matter at galactic centers and existence of electrical forces of interaction between the stars and galaxies, so far least suspected; identifying the fundamental particle of matter; revelation of conceptual errors in the modern understanding of the basic nature of light; vindication of Einstein's conclusion of the speed of light as the limiting speed; vindication of Descartes' principle of propertyless ether.

Will Science and Spirituality Merge?

A new edition of Paramahamsa Tewari's book *Spiritual Foundations* has just been released on his website, www.tewari.org. An abstract from Chapter 24 follows:

"The majority of scientists do not seriously attempt to recognize the basic deficiency in the fundamentals of current science and, therefore, they are not sure of the nature of the final evolution of science. For them, present scientific conventions represent the final truth, and it does not occur to them that despite the scientific and technological developments of the last few hundred years our present knowledge of the basic laws of science may be only partial and superficial. Thus they interpret the spiritual phenomena through the logic borne out of the current science and fail to have even a glimpse of the spiritual phenomena. This is not to say that all the knowledge of science is false. Knowledge based on the experimental evidence is right as long as the interpretation of the experiment is right. It can be said with conviction that current science has yet to attain a higher stage of development because its fundamentals are only descriptive today and not explanatory.

"Similarly most of the so-called spiritualists have only spiritual knowledge with no realization. Spiritual knowledge should be followed by spiritual experience, and then alone

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faith in the reality of spiritual phenomena develops. Spiritual experiences have to be sought in our day-to-day life. We do not need to go to a laboratory for spiritual experience. Science deals with the phenomena of matter and its effects in space. Current science is materialistic; it always deals with matter and its associated fields and, therefore, it is materialism that dictates science. Spiritualism on the other hand deals with the phenomena associated with the medium from which matter originates, the science of space (*Aakaash*), and its reality. For a scientist if there is no matter, there is no science. For a spiritualist, all the scientific phenomena emerge from the massless *Aakaash*, the eternal medium with nonmaterial properties—the *Sat-Chit-Ananda*. A spiritualist has not to pick up a piece of matter and go to a laboratory to experiment. He experiments with the conscious *Akaash* which is omnipresent. He therefore selects a secluded spot to meditate upon the Principle of Consciousness that is inherent in *Aakaash*. He desires to know how he got the consciousness in his material body due to which he is able to witness the magnificent play of nature. He directs his questions to the Conscious Universe (*Brahman* of the Vedas) and gets the answers through his experiences, during and after meditation. He experiences the Unity behind the diverse manifestations, the vast span of time and space, and the Consciousness pervading the universe. Without this experience he certainly does not fully realize spiritualism. Such a spiritualist has little conviction while discoursing on the Spiritual Truth just as a scientist basing his knowledge blindly on the experiments of others, falters while asserting that the current science reveals the final truth of the universe.

"A scientist knowing the limitations of science, and with an eagerness to improve upon it, can certainly look for help from spirituality. It is not the spirituality that has to compromise its laws; it is the science that has to revise its current notion. Science today cannot stand at par with spirituality. A scientist should be permitted to have the better of both science and spiritualism. Spiritual ideas have apparently suffered due to some invalid ideas of science. Science has to accept its limitations before it can claim its fitness to merge with spirituality. Science has to evolve further until it crosses the barrier of the material mind. It has to look into the Base, that created the material mind. It has to grasp the Principles of life and consciousness. It has to understand the Phenomenon of God. Where is the merger until then? How can the eternal fluid of spirituality merge into an inert and discrete materialism? Let us be patient and evolve science first before we challenge spiritual ideas.

"We are no doubt marching towards the merging point, as already proclaimed by our *Rishis*. The *Advaita* philosophy of Shankara is scientifically true, and the world will very soon realize the Truth behind the assertions of the Vedas, the declarations of the prophets and seers who preached universal brotherhood, motherhood of the universe, and fatherhood of God. For the further evolution of science, ideas that will be useful will be the mysticism peculiar to our land. The Western ideas on materialism have already played their role by providing enough useful experimental evidence and accumulated facts and figures.

"The creation and annihilation of matter has been scientifically demonstrated by the current science thus proving the transient nature of the visible worlds. We now need to know the agencies behind the fundamental phenomena—the 'whys' of physics. The nature of energy is to be understood. The properties of space have to be intuitively derived from the available scientific data. We have to pick out a single elementary material particle to construct the material universe and to establish the unity of the material worlds. We need to know the attributes of the single Substance, the nonmaterial *Akasha* to establish the Unity behind the diverse scientific and spiritual phenomena. We need to realize the agency of Consciousness, the principle of life and death, and the intelligence of the Universe. We can certainly know these phenomena through a scientific approach but the science that shall answer the above questions shall not be the current science. It shall be a new science inclusive of a spiritual base. And that shall set the stage for a merger of science and spirituality."

New Reviews of Tewari's work have been received from Dr. John A. Wheeler and Prof. Umberto Bartocci. A copy of *Universal Principles of Space and Matter* was forwarded this summer to Dr. John A. Wheeler at his summer residence in Maine. Dr. Wheeler saw the development of modern physics while working with Neils Bhor at age 27 and was a colleague of Albert Einstein's at Princeton. Credited with being the "father of the Black Hole Theory," Dr. Wheeler is well-schooled in quantum mechanics and relativity. Dr. Wheeler called the book "a unique gift." Further reviews of Tewari's work by Dr. Wheeler can be found at: http://www.tewari.org/Critical_Reviews/critical_reviews.html.

Prof. Umberto Bartocci, of the Universita di Perugia in Italy, writes: "This is a very singular book, in front of the current paradigm of contemporary Physics, a 'cartesian-inspired work which calls for reorientation in the foundations, by wisely warning that: '*The conclusion of the modern physics that absolute space, time, simultaneity*, and *space filling media are discredited ideas is certainly premature.*'" (p.178)

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METASTABLE HELIUM:

An Overlooked Rocket Fuel, Cold Fusion Catalyst, and Much More

Robert W. Bass*

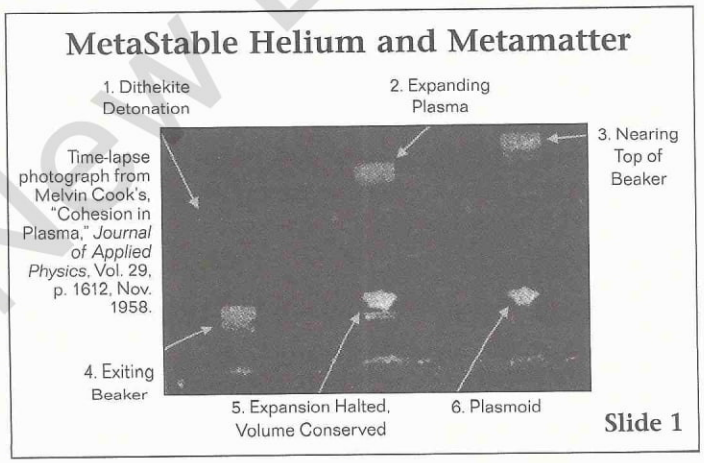
From a presentation given by the author at the Conference on Energy and Accountability in College Park, Maryland (November 9-10, 2002). See the full-color slides online at www.spacetransportation.com/ast/presentations/2b_bass.pdf. An updated version of this paper, and improved slides, can be found at the NASA website for ASPW2003.

Abstract

This presentation will describe conceptually new ways of storing, transmitting, and generating energy which can be realized through the production of "metamatter." In order to achieve this goal, two concepts need to be demonstrated. First, is it technically feasible to convert a gas into a pressure-ionized plasma in the state of liquid metal that is self-cohesively self-confined, yet fully ionized—a liquid metallic plasmoid (LMP)? Second, can an LMP be crystallized as it cools? The resulting crystal is metamatter. Depending on the gas used—helium, hydrogen, heavy hydrogen—this process will produce, respectively, crystals of metastable helium (MSH), metastable protium (MSP), or metastable deuterium (MSD). These crystals offer potentially revolutionary ways of addressing energy needs.

Slide 1: Cook's Accidental Discovery of a "Cryscapade" and Tuck's Independent Attempts to Replicate Ball Lightning Artificially

This presentation concerns a proposal to approach the creation of a solid crystal of metastable helium (MSH) via cooling of a mass of pressure-ionized helium in the physical state of a liquid metal or liquid metallic plasmoid (LMP).



The case for the existence of LMPs can be based upon two experimental findings (both involving use of a self-destructive explosive apparatus) and five independent theoretical predictions of the reality of LMPs.

After his retirement from leading decades of hot fusion research at Los Alamos National Laboratory (LANL), the late James Tuck (co-inventor of the Theta Pinch) took up the scientific study of ball lightning and published a review on the subject in *Nature* in the late 1960s and a more comprehensive Los Alamos Report in 1971. He later showed me and others slow-motion movies of an explosion which he had created by short-circuiting a submarine battery (undertaken because sailors had reported sighting fireballs while submerged). The film showed small floating fireballs moving toward the camera. Because of anecdotal evidence that ball lightning can roll off a table and bounce, Tuck concluded that these plasmas must have either "surface tension" or volumetric coherence, or both; he ascribed the latter to "dynamic Madelung forces," which are the same long-range, summed electrostatic forces that provide solid-state crystalline stability.

Quite independently and evidently unknown by Tuck, Melvin Cook, late Emeritus Prof. of Metallurgy at the University of Utah, had in 1958 already arrived at the same explanation for the evident stability in shape and volume of fireballs, which he had accidentally discovered during high-explosive experiments at the China Lake Naval Weapons Center. Using a streak framing camera, Cook and McEwan photographed a fireball every four microseconds for about 15 such time intervals, during which the size and shape of the fireball remained unaltered, even though its energy density greatly exceeded that of the ambient atmosphere. There are a half dozen such photos on the cover of the *Journal of Applied Physics*, Vol. 29, November 1958, showing six successive time-lapse

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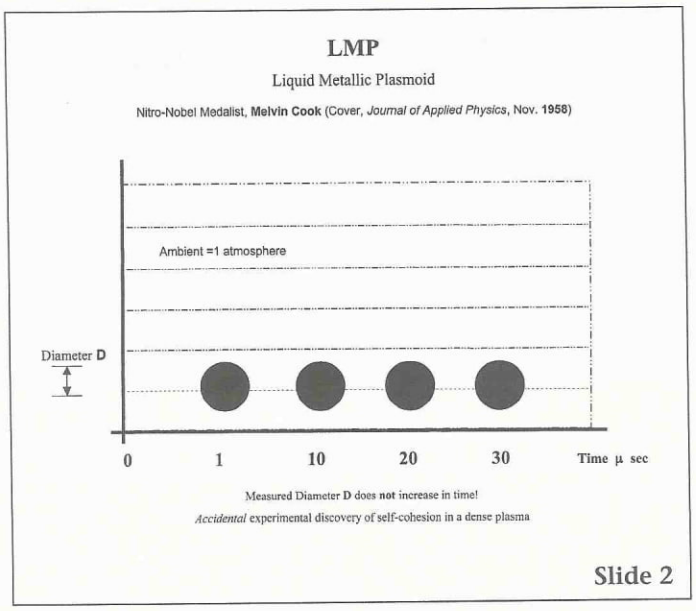
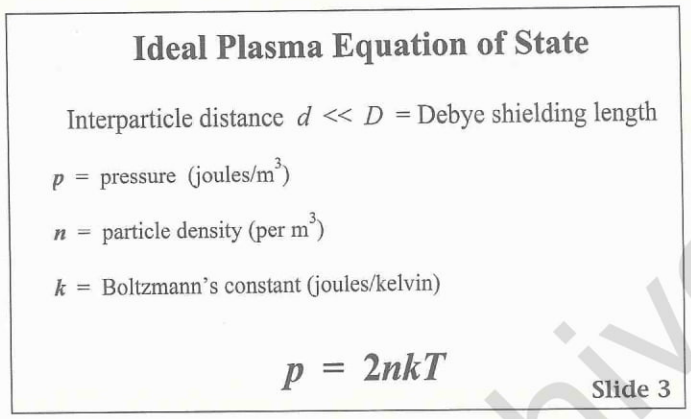


photos at 4 microsecond intervals. The leftmost photo shows a beaker of dithekite right after its detonation. The next three photos show a plasma exiting the beaker. The final two photos show this plasmoid remaining constant in volume and shape, even though its energy density is a hundred times that of the ambient atmosphere. If it were a gaseous plasma it would be expanding at the local acoustic speed. Cook therefore deduced that it was in the physical state of a liquid metal, in which the long-range summed electrostatic forces of cohesion exceeded the thermal expansive forces. He dubbed this fluid-crystal-plasmoid a "Cryscapade" and published a semi-empirical "dynamic-Madelung-force" quantitative theoretical explanation in his books on the science of high explosives.

Slide 2: Cook's Discovery Abstracted Schematically

Cook, who holds a doctorate in physical chemistry from Yale, in 1967 received the first Nitro-Nobel Medal in the century for the best work on the physical chemistry of high explosives since Alfred Nobel discovered dynamite. His monograph on the subject was published by the American Chemical Society and reprinted by the Krieger Reprint Corporation, which also more recently has published a new book by Cook called *The Science of Industrial Explosives*. In both of his books there are extensive Appendices treating his discovery, and he proposed theoretical explanation of an LMP using the terminology of a "cryscapade."

Slide 2 depicts in a slightly over-simplified manner the essence of Cook's discovery. Measurements of electron density showed that the fireball was ionized. However, if it had behaved like a gas, its diameter should have increased at the local speed of sound. In attempting to resolve this puzzlement, Cook realized that when a plasma is sufficiently [relatively] dense and at a sufficiently [relatively] low temperature, the electrostatic energy of cohesion must be subtracted from the conventional ionization threshold energy. For example, according to the Saha equation, a mono-atomic hydrogen gas will not become fully ionized unless its temperature exceeds 150,000 Kelvins. But Cook's fireball had a temperature of only a few thousand Kelvins! The explanation of the apparent discrepancy is that for dense plasmas, *pressure*



ionization becomes more important than thermal ionization. Cook presents a semi-empirical energy-balance formula for the "dynamic lattice" of an LMP, which shows thermal expansive forces overcome by electrostatic Madelung forces such as are considered in conventional solid-state physics. Cook's semi-empirical formula can be re-derived with more complete justification from the theory to be discussed next.

Slide 3: Ideal Plasma Equation of State

There is a good review of the statistical mechanical foundations of plasma kinetic theory in a chapter by Burton Fried of UCLA in the book *Plasma Physics in Theory and Application* (McGraw-Hill, 1966, edited by Wulf B. Kunkel). Fried shows that the actual expression for the energy density of a fully ionized and electrically neutral plasma is a convergent infinite series, of which only the first term is significant when the interparticle distance d is much less than the Debye shielding length D. This first term has the form shown in which the particle density (multiplied by two for the two species of particles, electrons and ions, which are present in equal numbers because of assumed average charge-neutrality) is multiplied by the average kinetic energy of each particle. This, of course, defines the average temperature, with Boltzmann's constant providing the factor of proportionality.

The similarity to the ideal gas law shows that if a plasma is in the state to which this equation applies, it will behave like a gas.

However, there are at least four published theories which attempt to estimate or approximate the sum of the neglected terms in the case wherein it may be significant.

In the case of a weakly non-ideal plasma, one may use the Deby-Huckel equation of state. Prof. Pozwolski of the University of Paris used this equation in publishing a theory of ball lightning's evident self-cohesiveness [in a European journal in the late 1970s], and, after learning about Cook's prior work, he sent a reprint of his paper to Cook pointing out the essential agreement between their respective theories.

However, in the case of a strongly non-ideal plasma, the Berlin-Montroll equation of state, though giving qualitatively similar results, is more accurate numerically and therefore for brevity is the only one to be presented explicitly here.

Slide 4: Plasma Equation of State (Berlin-Montroll)

As can be verified from the equation of state shown in Slide 4, which is the same as that of Slide 3 except for a dimensionless correction factor, the second term in the correction factor is negligible if (assuming only singly-ion-

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Plasma Equation of State (Berlin-Montroll)

p = pressure (joules/m^3)

n = particle density (per m^3)

k = Boltzmann's constant (joules/kelvin)

e = electron charge (Coulombs [= { joule-m }$^{1/2}$])

$$p = \{ (7/6) - [(2\pi)^{1/2} \cdot (e^2/2)] \cdot (n^{1/3} / kT) \} \cdot 2nkT$$

implies

$$p < 0 \text{ if } n >> (kT)^3$$

Slide 4

ized atoms) the ion density n is small in comparison to an appropriately-dimensioned constant 5.06 multiplying the *cube* of the temperature term kT [although the final pressure is now multiplied by 7/6 instead of 6/6].

But if the density is large in relationship to this factor proportional to the cube of the temperature, then the entire dimensionless factor changes sign!

In other words, the pressure becomes *negative*. Instead of providing a thermally expansive energy, the aggregate electrostatic forces have overcome the thermal or kinetic energy of the particles by providing a volumetrically *cohesive* potential energy!

At the time of this presentation to the 12th Advanced Space Propulsion Workshop (ASPW2001), we thought that there had been only four independent discoveries of the theory of LMPs being exposited here.

However, fortunately there was present a Prof. of Physics from the University of Nevada at Reno (UNR), F. Winterberg, who recognized the LMP theory being presented as virtually identical to that in his 1978 paper "Electrostatic Theory of Ball Lightning," *Zeitschrift fur Meteorologie*, Vol. 28, pp. 263-269!

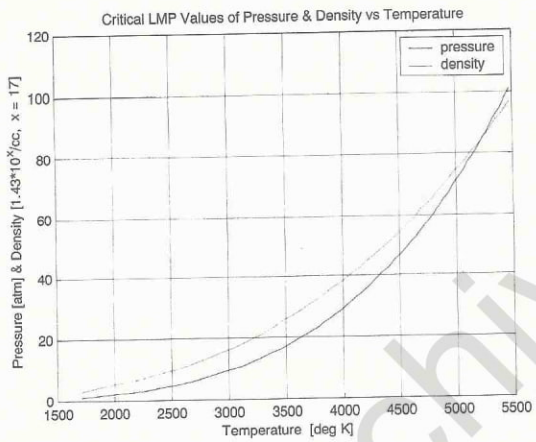
Winterberg had derived for a plasma an approximate Debye electrostatic potential in the form of a Yukawa potential, which [referring to the strong nuclear force rather than electrostatics] describes the liquid drop model of a nucleus and therefore suggests that a pressure-ionized plasma may indeed behave self-cohesively like a volume-conserving liquid metal.

Winterberg's critical density is of exactly the same form proportional to $(kT)^3$ as that mentioned above, except that the above-mentioned constant 5.03 becomes 9, *i.e.* a discrepancy of less than a factor of two (understandable in view of the approximations involved in using the Debye model of the plasma fluid).

Winterberg does mention that for more precise calculations one would need to include the effects of quantum-mechanical exchange forces, to which we now turn.

Slide 5: Brush-Sahlin-Teller Equation of State

The late Harry Sahlin (who had privately endorsed the theory of laser "spark" [fireball] generation presented in U.S. Patent 4,448,743, issued May 15, 1984, by Robert W. Bass) collaborated at Lawrence Livermore National Laboratory (LLNL) with Edward Teller in fusion-bomb research using this correction to the purely electrostatic type of theories mentioned so far. In this more complicated theory, quantum-mechanical exchange forces are not neglected. (See *J. Chem. Phys.*, Vol. 4, 1966, p. 2102, co-authored with physicist Stephen Brush of the University of Maryland.)



Brush-Sahlin-Teller Equation of State

Slide 5

In connection with classified Navy research pertaining to underwater technology (and therefore presumably to the high pressures available at great depths), H.E. Wilhelm published a theory of pressure-ionized plasmas in a liquid metallic state entitled "Ionization and Cohesion in Dense Plasmas," *IEEE Trans. on Plasma Science*, Vol. PS-8 (March, 1980), pp. 9-14, based upon the Brush-Sahlin-Teller equation of state. This equation is too complicated to present here, but a numerical example of the critical values of density and pressure in a hydrogenic plasma as a function of temperature is presented in Slide 5. It still turns out that around 90% of the cohesive energy is electrostatic, and the remaining 10% correction based upon quantum mechanics is needed only for very precise modeling. The cubic dependence upon temperature is visually evident.

Note that if one employed 40 atmospheres pressure, the temperature would have to be below 4,500 Kelvins, and at room pressure (as in ball lightning) the temperature would be less than 2,000 Kelvins.

The difficulty, of course, is to create a plasma fully ionized at such "low" temperatures, in the light of the fact that all conventional ionization procedures require bringing the gas to a temperature of over 100,000 Kelvins in order to ensure that it is fully ionized.

In summary, however, it would seem unreasonable to doubt the existence of LMPs (in view of the vast anecdotal evidence for natural ball lightning and the convincing experiments of Cook and Tuck), and there is no good reason to doubt the theory of LMPs sketched above, which theory was arrived at independently by five qualified scientists (Cook, Tuck, Pozwolski, Winterberg, Wilhelm), who started from accepted first principles and pursued different paths of reasoning and yet reached an essentially identical theory!

Slide 6: Blauer-Bass LMP Proof-of-Principle Process-Prototype Protocol

The late Jay Blauer, a renowned expert in both shock-tube technology and high-energy chemical laser technology, suggested to me that by appropriate adaptation of the laser spark technology in my cited patent, a definitive demonstration of the reality of LMPs under controlled conditions

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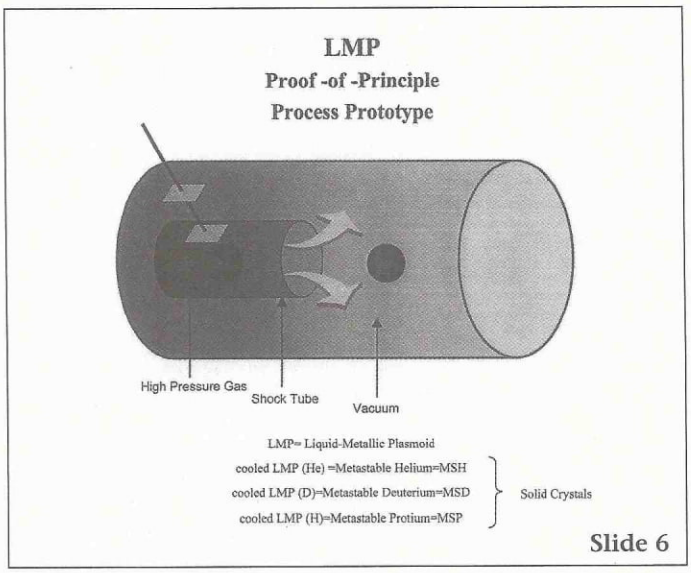


may be presented.

The cited 1984 patent was sponsored by the late Darryl Gammill upon the recommendation of his colleague Harry A. King III, and resulted in the published prediction of a double-electrostatic layer in the plasma-gas interface [R.W. Bass, I. Oh, and W. Schrader, *Fusion Technology*, Vol. 6 (1984), pp. 35-43]. This was done independently of a similar prediction [P. Lalousis and H. Hora, *Laser & Particle Beams*, Vol. 1 (1983), pp. 283-304] prior to its experimental observation [A. Ludmirsky *et al.*, *IEEE Trans. on Plasma Science*, Vol. PS-13 (1985)].

The cited patent provides an equation which optimizes the relationship between the following experimental parameters: 1) ambient gas pressure; 2) amount of initially projected energy; 3) focal spot radius of this initial energy; 4) wavelength of the radiant energy supply; 5) transparency of the plasma; 6) rate of bremsstrahlung radiation energy losses; and 7) duration of the energy projection, so as to create a fully ionized fireball of the type known as a "laser spark" and similar to the steady-state plasmas in the optical plasmotron of Raizer and the free-floating plasma-filament of Kapitza (rather than the transient plasma fireball of Bekefi).

Blauer proposed to modify the equation of Bass relating the seven cited factors to the conventional energies of dissociation and ionization (as in the Saha Equation) by following Cook *et al.* in *subtracting* from the usual ionization threshold energy the cohesive electrostatic potential energy from the five-times-rediscovered LMP theory already presented. Depending upon the wavelength of the laser selected, there are available crystal salts transparent to said wavelength, from which the small windows or ports shown in the figure may be fabricated. The inner concentric cylinder and the outer concentric cylinder are made of metal or similarly strong material and are gas-tight at high pressures. The inner cylinder has its end sealed by a metal foil which can be abruptly removed by pulsing a large current through the wire which welds it to the end of the inner cylinder, which is filled with gas at a relatively high pressure. (Here the word *relatively* must be stressed, for even a single atmosphere's pressure is high relative to the hard vacuum in the outer cylinder.)

When the modified laser spark process is initiated, it is expected to create an LMP within the inner cylinder. The shock tube is then opened by a current pulse and the high-pressure gas will flow out explosively into the external vacuum chamber.

If the preceding protocol is successful, the fireball will remain at a constant diameter even though the ambient gas is rapidly becoming as rarified as a near-vacuum (assuming a sufficiently large initial vacuum volume).

Because of the flammability of hydrogen, I propose to experiment first with the inert noble gas, helium. If the inner cylinder is at least under 20 atmospheres pressure, then the target could be a pellet of solid helium, which could be fully ionized by a conventional laser-spark and then cooled by expansion to ambient gas pressure with the parameters so chosen that in this final state the critical conditions for an LMP are met.

Slide 7: MetaStable Helium (MSH) Manufacturing Process

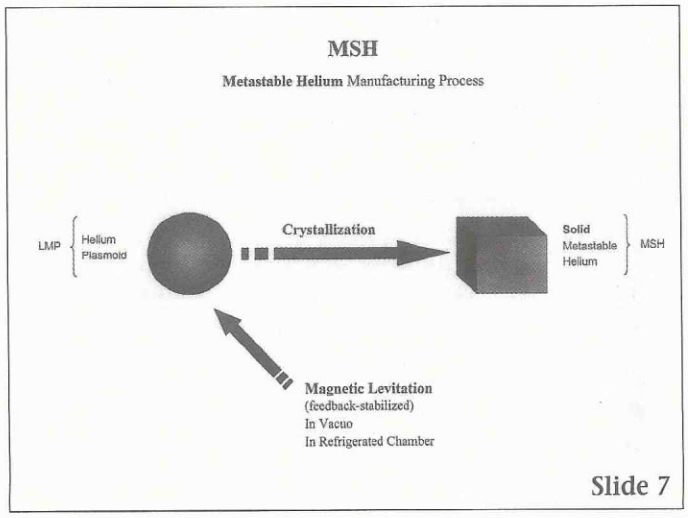
Assuming that the LMP protocol has been perfected, the next step is to create an LMP of helium in such a large outer chamber that (combining size with evacuation pumps) the LMP is for practical purposes in a vacuum.

Using off-the-shelf feedback-stabilized magnetic levitation systems, the LMP is then maintained in isolation from any other matter in a refrigerated vacuum chamber and allowed to cool by radiation.

The LMP theory presented indicates that as it cools the LMP shrinks in size and its internal cohesive energy becomes greater. The electrostatic cohesive energy then outbalances any destabilizing forces and the LMP becomes increasingly more dense.

It is not known yet from any available theory whether or not the LMP will crystallize as its temperature equilibrates with room temperature, but there is a good reason for expecting this, especially if an aligned magnetic field is added to the process in such as way as to polarize all electron spins identically up or down, because it has been demonstrated that if such a spin-polarized metastable crystal were *somehow* brought into existence then it *would* be stable and safe to handle under ordinary conditions.

In 1973 J. Zmuidzinas of the Jet Propulsion Laboratory (JPL) proposed that spin-polarized solid metastable helium would be an ideal rocket propellant, with an energy density between 40 and 100 times that of the best conceivable high-explosive or liquid-propellant combination. Because of conservation of quantized angular momentum, the transition of



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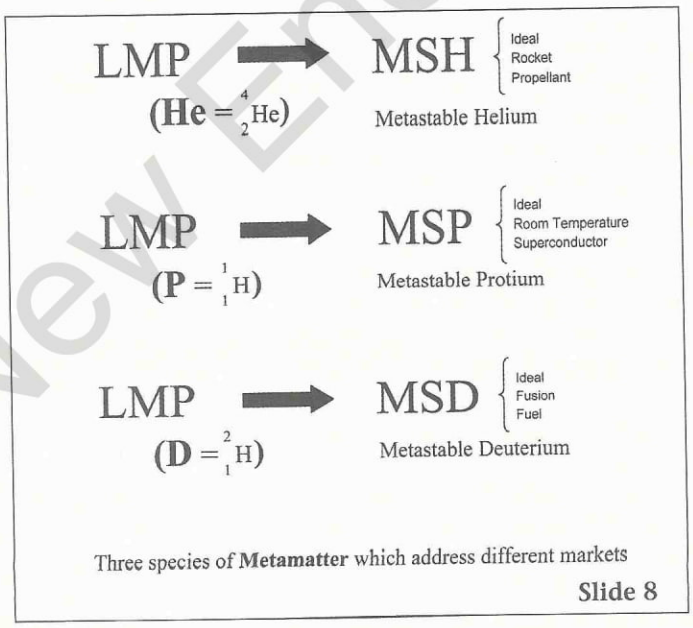
an excited helium atom, having both electron spins aligned, down to the ground state, where they are opposed, is not allowed. In vacuo an excited triplet state has a half-life of 2.5 hours. In 1985 M.L Tapper of JPL published a study of "Ground-state Energy Calculations for He IV-A," *J. Phys. C: Solid State Phys.*, Vol. 18, pp. 4217-4226, using both classical and many-body quantum calculations to estimate the cohesive energy of the He IV-A crystal at zero pressure and to indicate that FCC may be the preferred lattice structure and that the solid would be thermodynamically stable up to nearly 600 Kelvins. This work was continued by R.A. LaViolette *et al.* of Idaho National Engineering and Environmental Laboratory (INEL) in "First Principles Calculation of the Electronic Structure of Condensed Spin-Polarized Excited Triplet-State Helium," [*Phys. Rev. B: Condensed Matter*, Vol. 52 (1995), pp. R5487-90], who found BCC an even more favorable lattice structure, with over 1 eV of binding as a metallic *s-p* ferromagnet with a 1 eV indirect gap and a 4 eV direct gap, between the occupied spin-up and the unoccupied spin-down bands; the surprising existence of such a gap suggests that condensed He might indeed be a metastable solid.

If MSH could be manufactured in bulk it would have the same kind of specific impulse [3,150 seconds] as electric propulsion and yet the high thrust of combustion propulsion (*cf.* R.H. Frisbee, JPL D-1194, December 1983, *Final Report on Ultra High Performance Propulsion for Planetary Spacecraft*).

Although the Department of Defense's JASON advisory group in 1984 evaluated MSH as having "the same lifetime as a snowball in hell," causing the U.S. Air Force to discontinue the project, they also admitted that they had *neglected* collective effects and that it would be "possible to postulate a kind of snow that doesn't melt" which, to continue the metaphor, is *precisely* what the collective-effect cohesiveness of the hitherto overlooked LMP state provides! [Editor's Note: This same JASON group has many members who are and were active opponents of cold fusion research.—EFM]

Slide 8: Metamatter for Energy Storage, Transmission, and Generation

If the Blauer-Bass protocol for creating an LMP from helium works and can be reduced to practice as a manufacturing process, the next step is to try it starting with hydrogen (protium) and heavy-hydrogen (deuterium).



Three species of **Metamatter** which address different markets

Slide 8

Accordingly, we should consider in addition to MSH as an ideal energy-storage medium, the crystals of MSP and MSD as possible room-temperature superconductors and as a speculative new fusion fuel.

Indeed, C.F. Richardson and N.W. Ashcoft, in "High Temperature Superconductivity in Metallic Hydrogen: Electron-Electron Enhancements" [*Phys. Rev. Lett.*, Vol. 78 (1997), pp. 118-121], have "investigated the possibility of superconductivity in a dense phase" of metallic hydrogen, a prospect also predicted by M. Rabinowitz's phenomenological theory of superconductivity and superfluidity in materials whose interparticle distance is small relative to the corresponding deBroglie wavelength [*cf. e.g. Int. J. Theo. Phys.*, Vol. 33 (1994), pp. 389-399 and *Chem. Phys. Lett.*, Vol. 224 (1994), pp. 489-492].

Finally, note that since 1996 W.A. Nellis *et al.* of LLNL have been creating liquid metallic molecular hydrogen and deuterium (*cf. The Sciences*, July/August 1996, p. 12). For further references, see the cover story on the May 2000 issue of *Scientific American* [pp. 84-90], which headlines: "The Stuff of Jupiter's Core Might Fuel Fusion Reactors." These experiments involve liquid hydrogen or liquid deuterium at initial pressures of 93 to 120 gigapascals and having the pressure suddenly increased to 140 to 180 gigapascals by means of target-destructive gas-gun experiments; of course, the mention of fusion pellets [page 89 *loc. cit.*] refers to ablative compression inertial-confinement fusion (ICF).

However, the recent session of twenty-two invited papers at the winter meeting of the American Nuclear Society concerning the controversial subjects of low-energy nuclear reactions (LENR) and cold fusion raises the prospect that crystalline MSD might be the "perfect" lattice needed to bring cold fusion from a sporadic and poorly controllable process to a useful application, in accordance with the conclusion to C. Beaudette's recent book *Excess Heat: Why Cold Fusion Research Prevailed*, Oak Grove Press (2000), on page 301: "It may require that the [host lattice] be constructed one atom at a time in accordance with a tight specification."

Afterword: Personal Reminiscences of Interactions with Prominent Cold Fusion Skeptics

All that any of the cold fusion proponents have asked of the Department of Energy (DOE) is that the dismissive conclusions of the 1989 ERAB Report be reconsidered in the light of new evidence. By May 2000, the "new evidence" (*e.g.* at ICCF8) had become, to my mind, so impressive that it surpasses understanding that any informed scientist could examine the evidence with an open mind and not admit that the reality of the cold fusion phenomenon has been evidenced beyond a reasonable doubt. Specifically, the predominant source of anomalous heat can be explained quantitatively by the low-energy nuclear reactions.

[ANEUTRONIC] $d + d \rightarrow {}^4He + 24$ MeV (lattice phonons)

To quote Michael McKubre *et al.*, "in experiments performed using three different metal sealed cells, three different calorimetric methods, by electrochemical and gas loading means and with ^{4}He analyses made at three different institutional laboratories, there is observed a quantitative or

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Turner/Bush/Bass theory (related to work of Parmenter, Chubb, Kim, Li *et al*) of Resonant Transparency of Coulomb Barrier in Periodic Lattices

Quantum Resonance Triggering

Coulomb/Madelung/Fermi-Thomas/Mott Potential $V = V(r)$, $-\infty < r < +\infty$.
Bound Positively-Charged Particles at $r = \pm k.L$, $k = 1,2,3, \ldots$

Averaged electrons at mid-point between bound particles,
except for $-L < r < L$, where a unit-charge is smeared out as an electron cloud.

Schwinger Ratio = $L/(\pi \cdot \Lambda)$, Λ = rms amplitude of **Zero Point Fluctuations**

Potential validated by predicting Schwinger Ratio within one-third of one percent of measured reality.

QRT Principle: A host-lattice pair is suitable for Cold Fusion (in the sense that the so-called "Coulomb Barrier" is actually a resonantly transparent mirror), if and only if the Schwinger Ratio is closer to an **ODD** than an Even **integer.**

DECISIVE TEST: Consider 4 possibilities, wherein host lattice is either Palladium or Nickel, and positive particles are either Protons or Deuterons. Then host-particle pair is suitable for Cold Fusion if and only if it satisfies the QRT Principle, which turns out to be the case for Protons in Nickel and Deuterons in Palladium but NOT to be the case for Deuterons in Nickel and Protons in Palladium! Thus Principle predicts **non-obvious** truth in 4 out of 4 cases!

Slide 9

near-quantitative correlation between heat and ^{4}He production consistent with the [cited] reaction." Mentioning T.O. Passell, M. Miles, B. Bush, L. Case, Y. Arata, and Y. Zhang for enabling the reported work at SRI International, McKubre *et al*. said "truly we have advanced on the shoulders of giants."

Indeed a recent Naval Research Laboratory (NRL) report posted online (and available at www.LENR-CANR.org) concludes that "the time has come" for government funding agencies to take the subject of LENR/CF with the seriousness which its potential import deserves. And, in fact, modest support has now been forthcoming from DARPA, NASA, and the Army, but not yet from the DOE!

Alas, to quote Caltech Vice Provost David Goodstein: "I suppose that if nuclear fusion really does take place whenever [loading fraction] x is greater than 0.85, the world of conventional science eventually will be forced to take notice." [www.lenr-canr.org/acrobat/GoodsteinDwhateverha.pdf] Yet when this was published in the *American Scholar* on April 5, 1994, Goodstein wrote: "Unfortunately in this area science is not functioning normally. There is nobody out there listening." Sadly, nine years have passed and the situation remains the same.

During the past decade I have tried more than once to request certain prominent individuals, whose stature is such that if any of them changed their minds and called publicly for reconsideration of the ERAB Report, the DOE would have no excuse for continued foot-dragging. These individuals include:

(1) Admiral James Watkins, former Director of the DOE, over the ERAB panel;

(2) Princeton University Professor Physics, Will Happer, former Director of the DOE's Office of Energy Research which selected the ERAB panel;

(3) Princeton University's Albert Einstein Professor of Science, P. James E. Peebles, author of a Quantum Mechanics text published by Princeton University Press, which contains a six-page "proof" of the alleged "infinite improbability" of the cited reaction according to QM;

(4) Nobel Laureate and Professor of Physics at the University of Texas, Steven Weinberg, who has publicly compared the improbability of the cited reaction to the alleged "miracles" of various organized religions, whose improbability he has emphasized by adding ". . .and I don't believe in cold fusion."

When I spoke at the Integrity Research Institute's Conference on Accountability and Energy, I was asked to comment on my experiences in attempting to gain a hearing from these four eminent individuals. What follows is a condensed version.

(1) Admiral Watkins was gracious enough to take a phone call from me in September 2002, in which he reiterated his total confidence in the integrity and soundness of judgment of Dr. Happer, but declined to schedule a personal visit from myself, Dr. Scott Chubb, and others who wanted to give him a "layman's version" of the evidence. His basic position is that he is not a scientist, doesn't really understand the issues, and relies completely upon the advice of others in whom he has confidence.

(2a) Around the last quarter of 1991 I had the privilege of a personal and private discussion of the CF controversy, in the garden of the new Dean of Engineering at the University of California at Santa Barbara (UCSB), where Dr. Happer was the Guest of Honor at a conference, face to face for ten minutes or so. I asked him if he could recall any instance in the history of science in which there were large numbers of confirmatory measurements and yet the basic phenomenon was non-exis-

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tent. He replied, "What about the [Ptolemaic] epicycles?" I answered to the effect that while I agreed with his point that the physical interpretation of the epicycles was misleading, in a fundamental sense they were not wrong at all: take the Keplerian ellipse and expand it in a trigonometric series, and the amplitudes of the first few Fourier Coefficients will be just the amplitudes of the epicycles! His final comment was, "If Admiral Watkins is wrong about cold fusion, then I'll take the heat, because I am his principal scientific advisor!"

(2b) On the last day of the first Bush Administration, when top DOE officials were celebrating the completion of their tenure with an office party, I managed to reach Will Happer at the party by phone. He demonstrated then what I would consider to be the hallmark of the true "gentleman and scholar," because he voluntarily gave me some information which I had not known, which was helpful to my position, and which I was unlikely ever to have learned: "Ira Magaziner is a personal friend of [incoming President] Bill Clinton, and he has testified before Congress that more should be done to investigate cold fusion—you ought to talk to him." (Unfortunately consultant Magaziner has not yet answered my letters, even though I appealed to him as a fellow Rhodes Scholar, invoking the old school tie.)

(2c) I can't remember now whether it was via a phone conversation or an e-mail exchange, but more recently Will Happer has told me that his principal reason for skepticism about CF had never been theory-based, but rather the difficulty of replication. He commented that high-temperature superconductivity had been equally surprising, but within a short time it had been replicated all over the world, and now amateurs can buy a do-it-yourself demo "from Edmund Scientific!" I wish now that I had known then that Dr. Happer was the invited author of the article on resonance in the McGraw-Hill *Encyclopedia of Physics*, because to my mind the most penetrating theory of CF is that which I have called Resonant Transmission [see Slide 9] and Xing Zhong Li of Tsingua University has called at ICCF8 Selective Resonant Tunneling. It would be ironic indeed if Dr. Happer's own field of theoretical expertise were the key to understanding anomalous nuclear reactions in the solid state!

(3) Dr. Jim Peebles has treated me with exemplary kindness throughout the past decade. When I saw his section on CF in his 1992 QM book, I sent him an early draft of my paper with a closed-form expression of the relevant 1-D Coulomb/Madelung/Fermi-Thomas/Mott potential; he then sent me a letter saying that he thought that my closed-form as "worth publishing" but that "Madelung forces have [no relevance]" to the problem of overcoming the Coulomb barrier. I sent him an open letter (since printed in *Journal of New Energy/New Energy News)* which attempted to respectfully rebut that point, but when I phoned him he said that he "couldn't follow" my argument. So for the moment I gave up on that, but followed through on another reference which he had kindly given me that eventually led me to the pro-CF work of Nobel Laureate Willis Lamb and his collaborator Robert Parmenter, who has now at the end of his paper acknowledged me as stimulating him to "re-examine" the matter of resonant tunneling. Therefore I sent Dr. Peebles the proof-sheets of the forthcoming Parmenter 3-D paper on CF with request for a publishable comment. Peebles did graciously reply, and allowed us to publish in *IE* #21 (p. 44, 1998) his astute observation that "Parmenter. . .got to the right physics in equation (25), but I believe messed up in. . .(27), and I can make no sense of his resonance equation (32). In short, I see no reason to change my mind." As a mathematician trained in mathematical rigor, I have to agree that Parmenter was reasoning by analogy at that point: since the amplitude of a classical harmonic oscillator grows without bound in proportion to elapsed time when excited by a resonant forcing term, he stated that the wave-function amplitude of a resonantly forced quantum-mechanical harmonic oscillator similarly grows linearly in time without bound (leading to resonant tunneling in a matter of hours instead of the eons claimed by Jaendel, by Rabinowitz and Worledge, and by Merriman in their objections to the resonant transmission theory). Since then both Scott Chubb and Michael Ibison have been kind enough to send me detailed mathematical proofs that the quantum-mechanical harmonic oscillator does have the resonant behavior required by Parmenter and justly questioned by Peebles. Sad to say, neither I nor Scott nor Michael can now locate in our computer files these proofs, and unless I can get the project funded I hesitate to impose upon their time by asking for them to rederive the result again! Moreover, when I have asked Jim Peebles via e-mail if he would accept the Parmenter argument as valid if I could supply him with a mathematically rigorous demonstration of this one missing point, he has not yet answered. If he will answer the present query on this one key point, then I'll attempt to get the Chubb/Ibison proof resurrected and see if it is found convincing by the Albert Einstein Professor of Science at Princeton University—which should carry much weight at the DOE!

(4) Once when I was driving through Texas en route to presenting a seminar on CF to a class taught by Professor John O'M. Bockris of Texas A&M, I phoned Dr. Steven Weinberg at the University of Texas (UT) in Austin and offered to stop by to show him theoretical arguments to the effect that CF is not truly excluded by conventional QM (when the resonant tunneling in a periodic lattice is taken account of according to Bloch's Theorem [a key point which I learned from Scott Chubb And Talbot Chubb].) Dr. Weinberg replied, politely and reasonably enough, that if he took the time to listen to work outside of his principal present interests he wouldn't have enough time to finish his own work. Fair enough! (I regret having had to do the same upon occasion to good friends of my own.) Nevertheless, the opinion of a Nobel Laureate is given such weight by laymen that it seems reasonable to ask him if he is using his stature in a societally responsible way by ridiculing the plausibility of a major discovery when he has not personally looked into the evidence enough to have an opinion of his own, rather than rely upon the views of others who may be equally misinformed—as Goodstein laments. ❐❐❐

About the Author

Dr. Bass received a B.A. in Physics from Johns Hopkins University (1950), an M.A. Oxon in Mathematics from Oxford University (Rhodes Scholar, 1952), a Ph.D. in Mathematics from John Hopkins University (1955), and completed Postdoctoral work at Princeton University from 1955-1959. He has served on the faculties of Aerospace Engineering Sciences (University of Colorado), Physics and Engineering (BYU), Electrical Engineering (UCLA), and Aero Engineering (Egyptian Air Academy). Dr. Bass is currently an applied mathematician working in communications engineering with BAE Systems.

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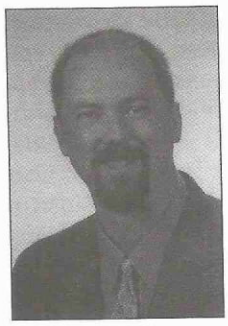
A Response to *Physics World's* "Review" of *Albert Einstein: The Incorrigible Plagiarist*

Christopher Jon Bjerknes



REVIEWS

John Stachel

Anti-Einstein sentiment surfaces again

Editor's Introduction: *Infinite Energy* #47 featured Dr. Thomas Phipps' balanced and generous review of Christopher Bjerknes' book, *Einstein: The Incorrigible Plagiarist.* Subsequently, *Physics World* in the UK ran a scathing, lengthy attack on the Bjerknes book (and on Einstein criticism in general) by one John Stachel. I was unaware of correspondence between Bjerknes and Stachel prior to the appearance of Stachel's review, and what appears to me to have been an *apparent* explicit e-mail rejection by *Physics World's* editor, Peter Rodgers, of Bjerknes' request for space to reply after the review came out:

Dear Christopher Jon Bjerknes:
Thank you for your letter. I will respond when I have had time to read and digest the letter but I cannot undertake to publish the letter unedited or in full.

Peter Rodgers
Editor, *Physics World*

I subsequently wrote to Rodgers to confirm the facts of *Physics World's* apparent rejection. Rodger's replied, in part:

"I received a letter by e-mail from Mr. Bjerknes on April 8. I read the letter and sent a non-standard acknowledgment by email on April 8. . .I then re-read the book review by Stachel about Bjerknes's book and obtained a copy of the paper in *Science* by Stachel and others that Bjerknes referred to. On April 19, before I had a chance to properly read this and think about the best way to proceed, I received a second e-mail from Bjerknes in which he withdrew his letter. It is therefore not true to say that the letter was rejected. . .I should also point out that almost all letters published in *Physics World* are edited and shortened. Moreover, the letter from Bjerknes was considerably longer than the letters we typically publish."

Whatever the disputed facts, we are very happy to be able to publish the Bjerknes' response, which—if correct in its well-referenced particulars—reveals an extraordinary duplicity on the part of Einstein and a cover-up of the facts by fawning supporters. — Eugene Mallove

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Infinite Energy was kind enough to publish a review of my book, *Albert Einstein: The Incorrigible Plagiarist* (IE #47, review by Dr. Thomas Phipps, Jr.). Dr. John Stachel also recently published a review of my book in the April edition of *Physics World* (see the review online at http://physicsweb.org/article/review/16/4/2). I submitted a response to the review to *Physics World*, but it was refused. *Infinite Energy* has kindly agreed to publish my response to Stachel's review.

In the April 2003 issue of *Physics World*, John Stachel, one of the early editors of Einstein's *Collected Papers*, published what he styled as a "review" of my book *Albert Einstein: The Incorrigible Plagiarist*.[1] The so-called "review" opens with a personal attack against me stated in particularly meanspirited terms in an alleged effort to justify the otherwise sacrilegious "review" of a book that dares to accurately and thoroughly document the history of the theory of relativity. No mention is made of the facts and circumstances which precipitated the production and publication of this *ad hominem* attack against me, and I can only imagine that an innocent reader who happens upon Dr. Stachel's statements will find them bizarre and inexplicable.

The truth of the matter is that John Stachel co-authored an article with Leo Corry and Juergen Renn, "Belated Decision in the Hilbert-Einstein Priority Dispute" in the journal *Science* (Volume 278, November 14, 1997, pp. 1270-1273), which rewrote the history of David Hilbert's well-established priority for the generally covariant field equations of gravitation. The claims made in this article relied largely upon a set of printer's proofs dated December 6, 1915 of Hilbert's famous November 20, 1915 Goettingen lecture, "The Foundations of Physics." Stachel claimed that David Hilbert's proofs did not contain generally covariant field equations of gravitation, though the final paper eventually published in 1916 on this lecture did contain generally covariant field equations of gravitation—the implication being that David Hilbert learned the equations from Einstein's November 25, 1915 lecture. However, Stachel did not inform his readers of a material fact in his sensationalistic article. Hilbert's proofs were mutilated at some point in their history, and a critical part of the proofs has gone missing. No one knows when the proofs were altered, or why. Prof. Friedwardt

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Winterberg of the University of Nevada, Reno, informed me of these facts in the late summer of 2002.

Prof. Winterberg has demonstrated that even in their mutilated state these printer's proofs show that Hilbert had the generally covariant field equations of gravitation, before Einstein. This constitutes positive proof of Einstein's plagiarism, because we have a letter from Einstein to Hilbert dated November 18, 1915 in which Einstein acknowledges receipt of a copy of Hilbert's manuscript, which Einstein had requested from Hilbert on November 15, 1915. The chronology is straightforward. Einstein received a copy of Hilbert's work on November 18, 1915. Hilbert delivered his lecture to the Goettingen Academy on November 20, 1915. Einstein betrayed Hilbert's trust and plagiarized Hilbert's work on November 25, 1915.[2]

I wrote to Dr. Stachel in September 2002, informed him that I intended to publish on this subject and asked him to state for the record why he did not mention the mutilation of Hilbert's proofs in his article in *Science*. A brief correspondence ensued, with Dr. Stachel behaving very much as he did in his subsequent "review."

Dr. Stachel's avowed reasoning for not mentioning the mutilation of the proofs was, *inter alia*, that the article was an incomplete and preliminary report. I observed that his explanation seemed to conflict with the title and tone of his article in *Science*, which was dubbed a "Belated Decision." I failed to find a statement in Stachel's report that it was incomplete and preliminary, and found that since this was the case, it was all the more reason to mention the fact that the evidence was mutilated, so that those reading the article could arrive at an informed opinion of its claims, and test them against the facts in the full light of day.

Stachel had tried to change the subject to a review of my book he said he intended to write sometime in the future. I ignored his queries in this line and he presented me with an ultimatum that if I did not answer his questions he would consider the "discussion at an end." I refused to allow him to change the subject, and so ended our brief correspondence. Apparently, Dr. Stachel did not deem it necessary to inform his readers of these facts and circumstances, which preceded his nasty "review" of my book in *Physics World*.

Dr. Stachel calls attention to the fact that in my book I quoted portions of Wolfgang Pauli's factual statements of the objective priority of Lorentz and Poincaré over Einstein, but quoted only some of Pauli's apparently insincere praise of Einstein—fully informing my readers that such praise follows in Pauli's article for the *Encyklopaedie der mathematischen Wissenschaften*.[3] Though I find Dr. Stachel's dwelling on this non-issue petty and a distraction from the real issues of Einstein's plagiarism, which Stachel conspicuously avoids throughout his undignified rant, he seeks to attack my credibility, and I am, therefore, compelled to respond to his poorly thought out remarks.

Dr. Stachel refers to a letter from Felix Klein to Wolfgang Pauli.[4] It appears to Dr. Stachel that there is a mutual exclusion between Klein's directive to Pauli in this letter, that he should credit Poincaré with Poincaré's innovations, and my contentions that it appears that Pauli felt forced, or compelled, to praise Einstein with evidently insincere comments after proving that Poincaré and Lorentz had created the special theory of relativity before Einstein.

No such mutual exclusion exits. The factual disclosure that Poincaré and Lorentz hold priority for the special theory of relativity rather requires that Pauli's statements of praise of Einstein be insincere, and indeed Pauli qualifies his statements, "in a way," which fact Dr. Stachel avoids addressing. All the elements of pressure and submission exist in Klein's letter, and one should bear in mind the stature of Felix Klein—then the world's leading expert on non-Euclidean geometry and one of the greatest of the great minds responsible for the reputation of the Goettingen Academy as a world leader in mathematics. In his letter, Klein directs Pauli as an authority, informs Pauli of his like for Einstein and Einstein's peculiar remarks, and makes clear to Pauli that he wants Einstein praised, albeit with the leftovers from Poincaré. Wolfgang Pauli was quite young at the time and Felix Klein's attitude towards Einstein must have served as a source of pressure on Pauli to praise Einstein, even after proving that Einstein did not originate the major concepts of the special theory of relativity. However, Felix Klein's attitude is but one factor among many. Einstein had recently emerged as an international celebrity, and this, too, must have served as a source of enormous pressure on Pauli to praise Einstein. But these are many words wasted on a non-issue. If Pauli was as sincere in his praise of Einstein as sincere can be, it would not change Pauli's arguments that Lorentz and Poincaré created the special theory of relativity, before Einstein—which subject Stachel avoids. John Stachel has apparently lost sight of the fact that I am not the issue, rather the history is the issue.

Far more interesting than Klein's directives to Pauli is Klein's statement that Poincaré, who stated before Einstein that the Lorentz transformations form a group, felt an animosity towards Einstein and that this was the sole reason why Poincaré did not mention Einstein in his Goettingen lecture "The New Mechanics."[5] Similar comments are found in the writings of Stjepan Mohorovicic, who pointed out that Einstein repeated (without an attribution) Poincaré's method of synchronizing clocks with light signals, and, as a result, Poincaré did not mention Einstein in the context of relativity.[6]

Dr. Stachel has tried to manufacture contradictions in my work which do not exist and has wandered off into odd lists of what he incorrectly believes I did and did not cite, and he is so vague and timid in his remarks, that I would be required to state the implications of his remarks in order to thoroughly contest them, and in so doing run the risk of being accused of misrepresenting him. I will instead leave it to my intelligent readers to understand that Dr. Stachel's comments are so petty, inappropriate, and insulting as to not merit further consideration.

However, it is noteworthy that in his long "review" Dr. Stachel nowhere mentions the fact that Einstein had an international reputation as a plagiarist throughout his career, and that his plagiarism was widely discussed in such reputable sources as the *New York Times*,[7] and in the scientific literature around the world. Nor does Dr. Stachel refer to the fact that the original 1905 paper on the principle of relativity was signed "Einstein-Marity,"[8] or the fact that the theory of relativity was known as the "Lorentz-Einstein" theory from 1905 through the 1920s.[9] There was apparently no room in Dr. Stachel's "review" for mention of the fact that the Einsteins' 1905 paper on the principle of relativity did not contain any references, though it was largely unoriginal; nor did Einstein's 1915 paper on the field equations of gravitation contain a single reference to the work of others, and it was clearly plagiarized from David Hilbert and Marcel Grossmann. Einstein clearly plagiarized the Lorentz transformation; as well as

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Poincaré's principle of relativity, and his concept of, and exposition on, relative simultaneity; and Einstein failed to acknowledge that Poincaré was the first to introduce the four-dimensional concept of space-time into the theory of relativity. Einstein's 1915 formula for the perihelion motion of Mercury is identical to the formula Paul Gerber published in 1898, as even Einstein's closest friends noted, with Einstein, under enormous pressure, eventually grudgingly acknowledging the fact in 1920.[10] Einstein's 1911 prediction for the deflection of a light ray around the sun is nothing but a repetition of the Newtonian prediction made in the 1700s, as Einstein acknowledged in his private correspondence in 1913; and Einstein's revised 1915 prediction comes remarkably close to duplicating the prediction Johann Georg von Soldner made in 1801.[11] Dr. Stachel completely avoided addressing any of the legitimate reasons for the numerous accusations of plagiarism and anticipation, which have been made against Einstein's work from 1905 onward.[12] His silence on these issues speaks loudly.

I share Dr. Stachel's concern for the abuse Mileva Maric suffered, with the difference between us being that I properly attribute that abuse, perhaps even physical abuse, to its source, Albert Einstein. I could quote some of Einstein's hateful and misogynist diatribes, or offer up the evidence of his perverse behavior, his neglect of marital and familial obligations, his smear campaigns against Mileva Maric, but since I have already addressed these issues and since Dr. Stachel avows that he, like me, is genuinely concerned for her, I will leave it to him to expound upon these important issues. Strange though, Stachel found no room in his article for citation of my praise for Mileva Maric, and my arguments in the alternative. It would be nice, and it would be appropriate, if he would leave me as a personality out of the history, and return to that history.

In conclusion, we should all acknowledge the importance of recognizing and recording the facts of the history of the theory of relativity and the history of the "insane publicity" which has promoted and which continues to promote Einstein, virtually to the exclusion of his predecessors. We face a moral imperative to give Einstein's predecessors justice, if only posthumously, and we must acknowledge their legacy. We have an obligation to the science of history to accurately record the past. It was for this purpose of accurately recording the history that I wrote my book. I am quite proud of my Jewish heritage, and if John Stachel wants to change the subject to anti-Semitism, I will join him in condemning it in all its forms, and go about the work of a historian recording the facts surrounding Einstein's career of plagiarism, even if it means enduring Dr. Stachel's petty insults. I do not think that alarmist slogans and attempts to render the subject taboo have any place in a scholarly exploration of the facts.

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Concerned with possible accusations of anti-Semitism against Christopher Jon Bjerknes, I asked the author to provide some background about his Jewish roots, which he refers to in his paper. He provided this most illuminating and delightful biographical portrait. —EFM

"My grandfather on my mother's side was Jewish. He was a renowned pianist and Mozart scholar, Nathan Sirkin. My great-grandmother on my father's side was Jewish, Ovidia Bjerknes. She sang before the Kaiser and he gave her a string of pearls for her performance. When the Nazis took over Norway, they put her out of her building and she died of exposure in a railway station. My great-great-grandfather was the famous aethereal physicist Carl Anton Bjerknes, son of Abraham Isaksen. I don't know if they were Jewish, but I read that he left Norway probably to escape the Swedes, who had vicious laws against the Jews, so he might have been, but there is also a story in the family that one of us burned a Swedish ship in a harbor in protest against the occupation, and the Swedes hanged him for it. Occupation has not been good for us. Vilhelm Bjerknes, also an aethereal physicist, and today most famous for his work in meteorology, helped rescue Heinrich Hertz' widow from the Nazis.

"I see my Jewish heritage as a love of scholarship, an ancient and effective moral culture, and a history of great humanity and integrity. My father could speak Yiddish, which he learned as a kid in New York. Most of my exposure to Jewish culture came about in the 1970s, through my Dad's best friend, Eddie Blumstein. Freud was a common topic at our holiday parties, as were grandmothers and guilt, if my boyhood memories serve me correctly. Eddie became a psychiatrist.

"My interest in Einstein began as a search into studies in gravitation. Carl Anton Bjerknes had a pulsating sphere theory of gravitation and electromagnetism in an ideal fluid aether. I wanted to know why the aether was abandoned, and why Einstein's theories were accepted, which theories I found irrational. I noticed that Einstein's formulations replicated Lorentz's, then discovered that Lorentz's duplicated Larmor's, which took from Voigt and FitzGerald. . . Whittaker's books were a revelation. On the internet I discovered that many other people had made the same discovery, and I also discovered the pernicious tactics used to perpetuate the mythology of relativity theory. After accumulating a great deal of the pedigree of some of these ideas in physics, I thought to write my book and document this largely forgotten history. I have a baccalaureate degree (summa cum laude) from Regents College of the University of the State of New York, with a concentration in sociology."

—Christopher Jon Bjerknes

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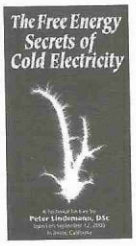

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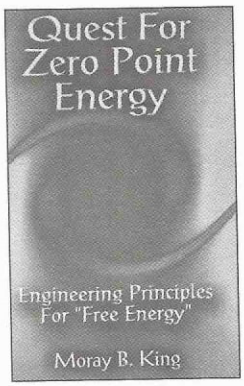
Short Course on LENR Announced

A short course on low-energy nuclear reactions (LENR) will be offered on Sunday, August 24, 2003, just preceding ICCF10. The course, organized by Dr. George Miley, will be held at the Royal Sonesta located in Cambridge, Massachusetts, site of ICCF10. Registration will be from 8:30 a.m. to 9:00 a.m. and the course will close at 5:30 p.m. The course registration fee of $130 ($60 for University/College students) will include: copies of notes, refreshments, and a light lunch. Space is limited, so advance registration is encouraged (contact Dr. Miley's office on e-mail at fsl@uiuc.edu or by phone at 217-244-4947). Lecturers will include: Drs. John Dash, Akito Takahashi, Peter Hagelstein, Mike McKubre, and Ed Storms.

Course Objective: This course is intended to provide an introduction to the field for persons interested in gaining a basic background in the science and technology aspects. Both theoretical and experimental topics will be covered for deuterium and proton based reactions.

9:00-9:15 a.m.	Introduction and Course Objectives (George Miley)
9:15-10:00 a.m.	Introduction to LENR (Ed Storms)
10:00-11:00 a.m.	Review of Experimental Measurements Involving DD Reactions (Mike McKubre)
11:00-11:30 a.m.	Coffee Break
11:30-12:30 p.m.	Review of Experimental Measurements Involving Transmutation Reactions (John Dash)
12:30-1:30 p.m.	Working Lunch, Discussion led by George Miley
1:30-2:30 p.m.	Theoretical Background for D Reactions (Peter Hagelstein)
2:30-3:30 p.m.	Theoretical Background for Transmutation Reactions (Akito Takahashi)
3:30-4:00 p.m.	Coffee Break
4:00-5:00 p.m.	Diagnostics for Measurements: Calorimetery, He^4, Transmutation Products and Isotopes, Radiation Emission, Metallurgical Analysis (George Miley, Mike McKubre, Ed Storms, and John Dash)
5:00-5:30 pm	Summary and Discussion (Panel, George Miley)



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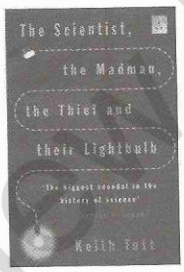

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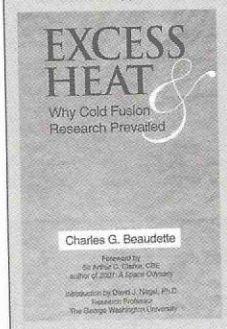

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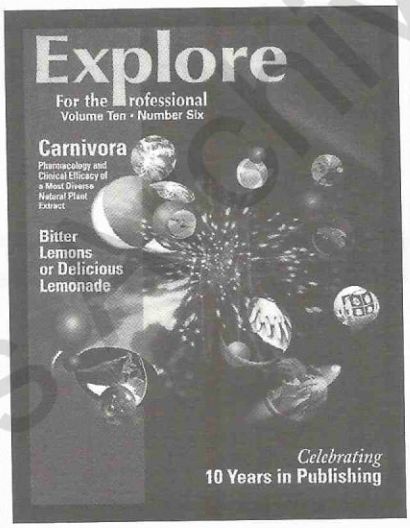

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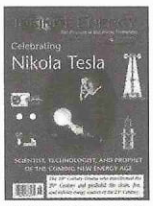

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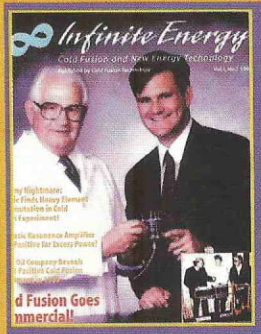

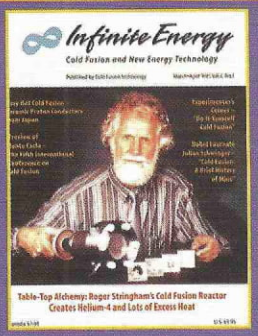

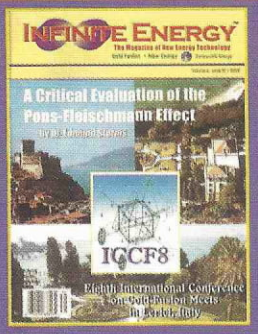

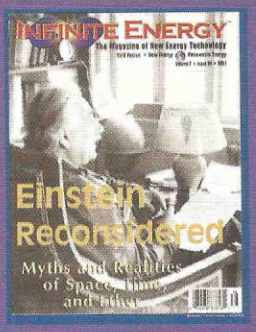

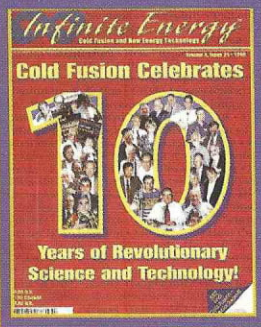

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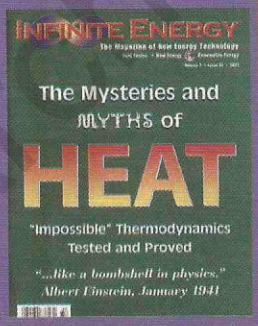

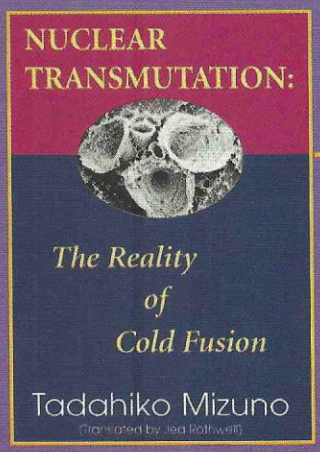

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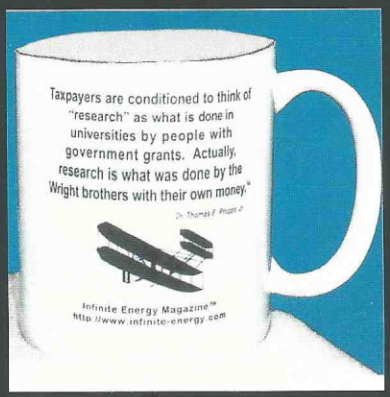

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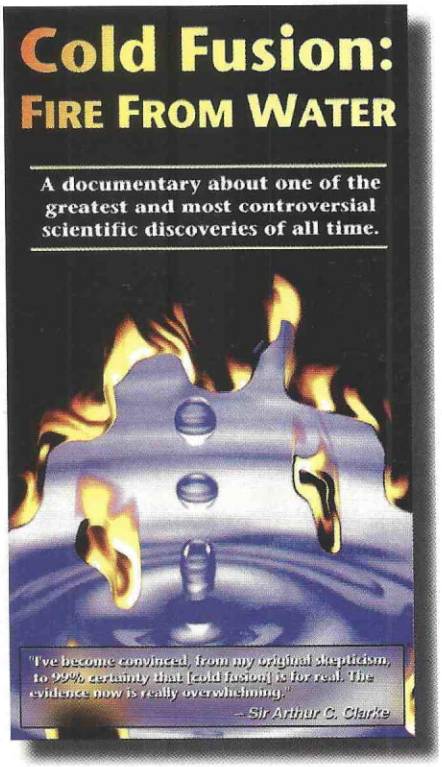

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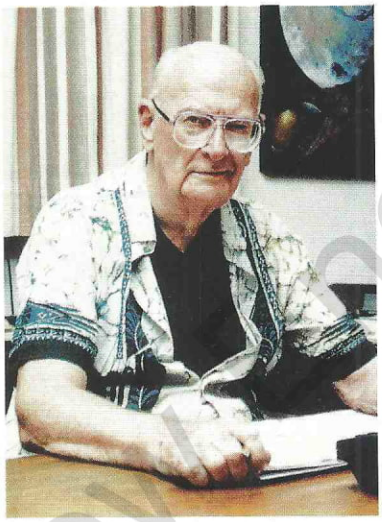

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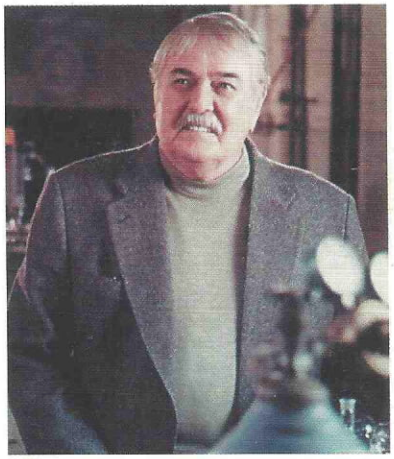

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